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A computer program for alternative analyses of attitude scales

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**A Computer Program for
Alternative Analyses of
Attitude Scales**

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A COMPUTER PROGRAM FOR ALTERNATIVE ANALYSES OF ATTITUDE SCALES

Submitted by

Li Yu

A Thesis
Presented to the Graduate Committee
of Lehigh University
in Candidacy for the Degree of
Master of Arts
in
Social Relations



Department of Sociology and Anthropology
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CERTIFICATE OF APPROVAL

This thesis is accepted and approved in partial fulfillment of the requirements for the degree of Master of Arts.

26 April 1994
(date)

Professor in Charge

Chairman of Department

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ABSTRACT

The thesis develops a computer program for the analysis of multiple item attitude scales with fixed response alternatives (e.g. agree strongly, agree, uncertain, disagree, disagree strongly, given the numerical values 1, 2, 3, 4, 5, respectively). When implemented on a mainframe computer, it can handle up to 26 items, each with up to 9 response levels, for 999 respondents. (When implemented on a P.C., the capacity is, of course, less.) The program is available on disks, and is given in the appendix to this thesis in *FORTRAN 77*.

It presents Guttman Scale Analysis for dichotomized items, displaying all response patterns and computing Guttman's Reproducibility Coefficient. It computes Green's estimate of the Chance Reproducibility Coefficient assuming all items uncorrelated with each other, and the Green B Index of Consistency. (None of these are available on standard statistical packages such as SPSS-X or SAS.)

Using the full range of item responses, it computes the coefficient alpha form of the Kuder-Richardson reliability coefficient, the average inter-item correlation, and corrected item total correlations.

Explanations of these indices are provided, as well as instructions for data input and output interpretation. Sample outputs on real data are also provided in an appendix.

1. INTRODUCTION

This thesis develops a computer program for attitude scale analysis, concentrating on Guttman Scale Analysis methods and also presenting psychometric methods of reliability and item analysis. Guttman Scale Analysis has been the most used method, particularly in sociology, but is not available in standard statistical packages such as *SASS-X* and *SAS*. While less used in recent years, it is still very important conceptually, in teaching the concept of unidimensionality. The psychometric analyses that are also included in my program are for the most part available in the larger statistical packages, but are included in my program for convenience.

The computer program was developed in *FORTRAN77* language. The program includes three main stages: (1) data input and reduction, (2) scale analysis using various scaling techniques and calculating all the related coefficients regarding error, consistency and validity, etc., and (3) output of results.

A data input manual is provided with the program so that users of all levels are able to create the data file easily.

The soundness of the program is checked through two ways. First, wherever possible, a sample problem is checked using either *SASS-X* or *SAS*. Second, for those functions which cannot be checked by available programs, a hand calculation is done for checking purpose.

Two illustrative examples are presented in detail so that the procedure of making attitude measurement with the program is shown clearly. The example problem starts

from the problem statement, the choice of variables and scaling method, the creation of input data files, and the format of output file produced by the program.

Appendix A explains how to set up the data file which will be made by the user of the program. *Appendix B* contains the information on how to execute the program. *Appendix C* gives the two sample data files and the two results files. *Appendix D* is the listing of the program in *FORTRAN77*.

2. GUIDELINES AND METHODOLOGIES IN ATTITUDE MEASUREMENT

2.1 Guidelines

Attitude measurement includes questionnaire design, scale development and analysis of the scale. There is always some discrepancy between the “true” value of that which a scientist wants to measure and the readings given by his instrument. People who respond to a direct question regarding beliefs or feelings may or may not report them accurately. There are all compelling reasons, conscious and unconscious, why persons may not give completely accurate self-reports. Before constructing the questionnaire, the following considerations must be taken into account: 1) Focus only on the present, because, the further back into the subjective past one attempts to delve, the more unreliable and invalid the data. 2) Avoid items that are factual, or capable of being interpreted as factual, because the interest is not in facts, but in opinions and attitudes, etc. 3) Avoid questions that may be interpreted in more than one way. 4) Avoid questions that are likely to be endorsed in the same way by almost everyone or by almost no one. 5) Avoid questions that are too direct. 6) Select items that cover the entire range of the affective scale of interest. The Likert Scale format is the most popular method and is chosen here. In this scaling, the respondents will indicate their attitude by choosing from 1 to 9 degrees of agreement or disagreement with each item. 7) Try to keep the language simple, clear and direct [DeVellis, 1991].

Here is an example of an attitude scale using items selected from a study by Professor Joan Spade:

1. Strongly agree
2. Somewhat agree
3. Uncertain
4. Somewhat disagree
5. Strongly disagree

- A. Most women are sly and manipulating when they are trying to attract a man.
1 2 3 4 5
- B. Women have the same needs for a sexual outlet as men.
1 2 3 4 5
- C. When women go around braless or wearing provocative clothing, they're just asking for trouble.
1 2 3 4 5
- D. If a girl engages in necking or petting and she lets things get out of hand, it is her own fault if her partner forces sex on her.
1 2 3 4 5
- E. A woman who initiates a sexual encounter will probably have sex with anybody.
1 2 3 4 5
- F. In a dating relationship a woman is largely out to take advantage of a man.
1 2 3 4 5
- G. Many times a woman will pretend she doesn't want to have intercourse because she doesn't want to seem loose but she's really hoping the man will force her.
1 2 3 4 5
- H. Any healthy woman can successfully resist a rapist if she really wants to.
1 2 3 4 5

For these items, the scale is arranged so that the lower score indicates the woman's fault and higher score indicates the man's fault. As the attitude goes from strongly agree to strongly disagree, the number of the answer goes from 1 to 5. In my work, I have taken a sample of 100 students from Dr. Spade's data file for illustration. The answers underlined in **boldface** are the answers from respondent 001.

2.2 Methodologies

(1). Guttman Scalogram Analysis

The major method used in this program is the Guttman scaling method because it is the major tradition of deriving a single score for an individual. It has become popular among social scientists. Guttman Scalogram Analysis is a technique for ordering respondents on the basis of their responses to attitude items. This scale technique is based on two assumptions: (1) a set of items can be ordered along a continuum of difficulty or magnitude, and (2) such a set of items measures a unidimensional variable. A Guttman scale is a series of items tapping progressively higher levels of an attribute. A respondent should endorse a block of adjacent items until, at a critical point, the amount of the attribute that the item expresses exceeds that possessed by the subject. None of the remaining items should be endorsed. Guttman encouraged collapsing response categories to improve reproducibility, commonly carried to the extreme of dichotomization. For these reasons, this program deals with Guttman Scalogram Analysis only in its dichotomous form of 0 and 1. A 1 is equivalent to possessing more of the attribute being measured, 0 equivalent to possessing less of the attribute. Each

individual receives a pattern of 1's and 0's to represent his responses to items in the scale. From this, each respondent is assigned a single overall score representing his position on the trait or dimension being measured. If the data are in the form of multilevel response categories, this must be dichotomized for the analysis. (This is performed in section II of the program.) Rules for dichotomization will be discussed in the next section. Sometimes, a dichotomous cutting point depends on the frequencies or percentages. Sometimes it is done on a priori semantic grounds.

For clarity, let us pick up 4 items (A - D) and 5 responses (001 - 005) from Dr. Spade's data file (*Example 1*) for demonstration of Guttman scale technique. The data below is copied from the data1 file:

ITEM					
ID	A	B	C	D	Total
(001)	3	1	2	4	10
(002)	2	2	3	3	10
(003)	1	2	1	5	9
(004)	5	1	5	5	16
(005)	4	2	2	3	11

The numbers inside the parentheses are used as the reference ID number. They are the identification number used in data1 (see *Appendix C*). The answers now are in Likert Scale format. For Guttman scaling, we need to transform the 5-level answer to a dichotomous answer. It is certainly understandable if we group "strongly agree" (1) and "agree" (2) as category 0. It is also understandable if we group "disagree" (4) and

“strongly disagree” (5) as the other category 1. You can take “uncertain” (3) either to the new category of 0 or to category 1. The cutting point can be shifted. This shifting obviously changes the proportion of respondents endorsing the item. It can make a preferred marginal distribution or make an unscalable item scalable. For this example, we assign “uncertain” (3) to category 0. According to this, people who answered the items with 1, 2, 3, will be replaced by 0; people who answered the items with 4, 5, will be replaced by 1. In *Example 1*, responses to each item are dichotomized so that people who answered 0 show his/her attitude of woman’s fault. People who answered 1 show his/her attitude of man’s fault. The new dichotomized data then becomes:

ID	ITEM				Total
	A	B	C	D	
(001)	1	0	0	1	2
(002)	0	0	1	1	2
(003)	0	0	0	1	1
(004)	1	0	1	1	3
(005)	1	0	0	1	2
Total	3	0	2	5	

The total score of each respondent is calculate in the far right entry and the total of each item is calculated in the bottom row. They are the popularities we are looking for. The popularity is determined from the data sample. The entries and rows of the above pattern can be rearranged in terms of increasing popularity of items. The rows, or persons, can be rearranged by the number of items on which they scored a 1.

ITEM						
ID	B	C	A	D	Total	Error
(004)	0	1	1	1	3	0
(002)	0	1	0	1	2	1
(001)	0	0	1	1	2	0
(005)	0	0	1	1	2	0
(003)	0	0	0	1	1	0
Total	0	2	3	5		

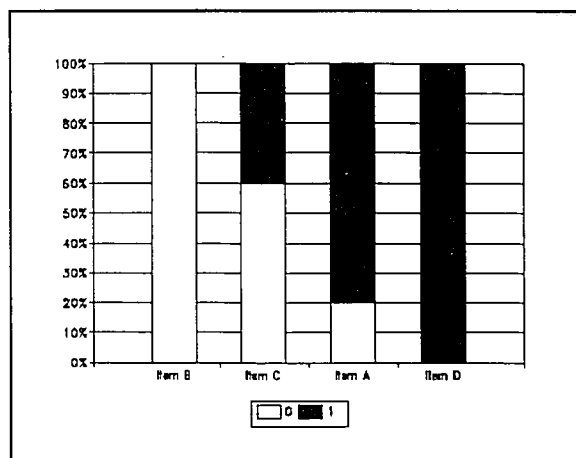
The popularity for the items now goes low to high from left to right. The frequency of 1's for the respondents goes high to low from top to bottom. If there were perfect reproducibility, there would be a solid triangle of 1's, and each person's responses would be perfectly "reproduced" by knowing his scale type, or total score. The essence of Guttman Scalogram Analysis — counting the number of errors or number of times each person disagreed with his overall pattern of responses. In respondent 002's answer, at least one error exists, depending upon how we assign the person to ideal scale types. Either item A is an errorful response or item C is an errorful response. It is an error because in the Guttman Scale Analysis, when items are arranged in order of increasing overall popularity, each person in the sample should agree with this ordering. Any deviation from this pattern should be considered an error. In the particular example, there are four ideal types, except the answer from respondent 002.

The non-scale type of respondent 002 is compared with each scale type to determine which comparison minimizes error. The non-scale type can then be assigned a Guttman score equal to that scale type which minimizes the error. Most non-scale type response patterns can be placed within the scalogram without ambiguity. If more than

one scale type satisfies the minimum error criterion (in this example, both scale type 3 and 1 will satisfy the rule), the non-scale type is assigned to the ideal type that minimizes error and has the highest frequency of response. (In this example, type 3 and type 1 have the same frequency due to the small sample size.) If we make a correction for person 002 to type 3, i.e., make his/her answer on item A as 1 instead of 0 (see the bold and underlined number below), then the new pattern will be:

ITEM					
ID	B	C	A	D	Total
(004)	0	1	1	1	3
(002)	0	1	<u>1</u>	1	3
(001)	0	0	1	1	2
(005)	0	0	1	1	2
(003)	0	0	0	1	1
Total	0	2	4	5	

All the above patterns are considered “ideal scale types.” The non-scale type pattern is now merged with the scale type patterns. In the general case, for a k item scale, there are $k+1$ ideal patterns. They are often represented in terms of bar diagrams. The above patterns of responses can be pictured as a bar diagram:



The bars show the percentage distributions for the respective questions. We can think of an ordering of the persons along a horizontal axis. The bars in black indicate the percent scoring 1 for each item. Items are ordered from left to right in terms of their popularity. Item D has 100 percent 1's, item A has 80 percent 1's, Item C has 40 percent 1's, while there is 0 percent for item B. Thus item D is the most agreeable answer of man's fault, while item B is the most agreeable answer of woman's fault among the five responses.

Attitude measurements are meaningful only when they accurately reflect the attitude. Reliability and validity are the two important guides. Reliability of a Guttman scale involves the use of a special coefficient of reproducibility. The reproducibility is to measure the degree of approximation of scale perfection. Guttman originated the term reproducibility — the extent to which the pattern of an individual's responses can be predicted or reproduced from their scale scores [Guttman, 1944]. It is used for the estimation of internal consistency. Any person who passes the most difficult item should have also passed all items of lesser difficulty. The major criteria for evaluating scales in this tradition is the extent of reproducibility of the pattern of responses to items from the total scores. The more exact the prediction of an individual's pattern of scores, the higher the reproducibility of the scales.

The Guttman Reproducibility Index can be calculated by comparing the total number of errors (E) to the total number of responses. The total responses come from the number of respondents (N) multiplied by the number of items (k). Only for comprehension purposes, Guttman chooses to subtract this proportion from 1. So that

the higher the index, the better the scale. In practice, 85 percent perfect scales or better have been used as efficient approximations to perfect scales.

The formula is as follows:

$$Rep = 1 - \frac{\text{Number of Errors}}{\text{Number of People} * \text{Number of Items}} = 1 - \frac{E}{Nk}$$

(2). Green Index of Consistency

Guttman's calculation of reproducibility will be contrasted with Green's calculation of reproducibility. Since there is no attention paid to the chance levels of reproducibility from Guttman, Green's reproducibility turns out to be the better one. It pays attention to both the obtained and the chance reproducibility. One advantage over the Guttman scaling method is that it doesn't involve sorting and rearranging the individual responses in order of scaled response type. However, the items have to be rearranged in order of popularity entries in the item response matrix. It finds a rule for counting the errors in any particular response pattern, and becomes a relatively simple method of scalogram analysis in which summary statistics are used to compute a close approximation to the scale reproducibility. This method has other advantages: 1) it removes scalogram analysis from the list of subjective, slightly mystical techniques available only to experienced practitioners, and places it on the list of objective methods available to any statistical clerk, 2) there is no limitation on the number of respondents and can be easily used for large numbers of items, and 3) it substantially reduces the time required for analysis [Green, 1956]. It gains these advantages at the expense of

providing only an approximation to the Guttman reproducibility. Certain high-order scale errors are ignored, but the approximation appears to be a very close one.

First of all, we will do the steps necessary for the calculation of Green B Rep (reproducibility). To calculate the Green obtained and chance reproducibilities, the steps include: 1) counting errors along the columns of the scalogram, rather than the rows or persons as in the Guttman approach, 2) comparing the actual number of errors to the potential errors, and 3) computing the chance level. Dichotomized items are needed for Green's method.

Green uses letter g as an indicator of each column. For the formula below, g refers to all observations of 1 in column g , \bar{g} refers to all observations of 0 in the column. We will calculate the number of errors of all the responses for each of the possible g columns when g is counted from right to left. If N be the number of respondents and k be the number of items, the summarized Green Rep_B formula should be as follows:

$$Rep_B = 1 - \frac{1}{Nk} \sum_{g=1}^{k-1} n_{g+1, \bar{g}} - \frac{1}{N^2 k} \sum_{g=2}^{k-2} n_{g+2, \bar{g}} n_{g+1, \bar{g}-1}$$

The value Rep_B is the obtained coefficient of reproducibility. It should be very close to Guttman's reproducibility.

The summarized Green Rep_I formula is:

$$Rep_I = 1 - \frac{1}{N^2 k} \sum_{g=1}^{k-1} n_{g+1} n_g - \frac{1}{N^4 k} \sum_{g=2}^{k-2} n_{g+2} n_{g+1} n_g \overline{n_{g-1}}$$

The value Rep_I is Green's chance expected coefficient of reproducibility, i.e., the Rep that would be expected by chance if the items were actually independent and are a function of the item popularities. It selects the best approximations to the total number of ways of counting errors and compares the number of errors received with the total possible number of errors.

Then, to compute the Green B Index of Consistency:

$$I = \frac{Rep_B - Rep_I}{1 - Rep_I}$$

The Green B index I is derived from the Green B reproducibility. Basically, the Green B index represents an approximation to counting all combinations of errors that deviate from the ideal 01 pattern when items have been ordered in ascending popularity. It compares the difference between the obtained frequency and chance frequency divided by 1—chance frequency. This comparison then becomes similar in form to Guttman's reproducibility coefficient. There will be unity if the items are perfectly scalable and have an expected value of zero when the items are independent. Green uses the criterion of $I \geq 0.5$ for a set of items to be scalable. If the items show some negative correlation, the index may also be negative. In my program, if the I is less than 0.5, the message of "This set of items is not scalable" will be printed after the value.

(3). Kuder-Richardson 20 and the Inferred Kuder-Richardson 20

Two more methods of estimating reliability based on comparing item variances and total variances are discussed. From each of these indices it is possible to infer an estimation of the overall average correlation of items. These methods can work on either dichotomous or multilevel responses.

The first one is the coefficient alpha, also known as the Kuder-Richardson 20. It compares the variance of responses to each item to the variance of the respondents' total scores. It has been concentrated on by many researchers since this approach provides us with a bridge to the analysis of scales with multi-level scored items, as we are comparing item variances and total score variance. Therefore, unlike Guttman and Green analyses, it can be based upon either dichotomous or multilevel data. My program can do both. Basically what the Kuder-Richardson does is to sum the variances for each item and compare it to the variation of the total score. If a person is in the middle of the distribution of responses to an item, his total score should also be in the middle of the total score distribution. We can compare the item and total variances with the following formula:

$$\alpha = \frac{k}{k-1} \left[1 - \frac{\sum \sigma_i^2}{\sigma_T^2} \right]$$

The ratio of the two numbers in the formula is the ratio of the sum of the item variances (the numerator) and the total score variance (the denominator). It reflects directly the goodness of the score. For the whole formula, the larger the value, the better the reliability. The maximum value of the statistics is equal to 1.

From the reliability of the scalogram, another measure of internal consistency — the inferred average inter-item correlation — can be obtained by applying a derivation of the Spearman Brown formula:

$$\frac{Reliability}{k + (1-k)(Reliability)}$$

The inferred average inter-item correlation is an estimate of the average correlation among items. This statistic is particularly useful as it will not vary with the number of items as does the reliability coefficient, and, therefore, is very useful in comparing reliabilities across scales differing in number of items. (The Guttman Reproducibility Coefficient and those of Green are also invariant over the number of items.)

(4). Inter-Item Covariances and Pearson Product-Moment Inter-Correlations

Researchers are encouraged to examine closely the inter-correlation of each item. The inter-item covariance is done by the program to see the correlations of each item with every other item. In my program, these correlations are based upon multi-level scoring only. The program also assumes that all extra criteria are in the form of interval data. To standardize the correlation between pairs, the Pearson Product-Moment correlation coefficients are also given by the program. It is a measure of the linear association between two variables. It tells you whether a person who is high on one variable is also high on the other and vice versa. It is a degree to which persons maintain or do not maintain their interval rank relative to the mean of the distribution.

If two items are measuring one factor, then all respondents should maintain their relative position on the two items. If there is no maintenance of relative position, either unreliability of the measures or the presence of more than one factor is to be inferred. The maximum coefficient is 1 when the item is correlated with itself. The coefficient is 0 if the two items are totally independent. Negative, as well as positive correlations, are possible, but, in a good scale, all items should correlate positively with each other.

(5). Item-Total Correlations

When scales are formed in the Likert tradition, the item-total correlations are one of the better indicators of an item's relationship or association with the whole scale, the best index of the underlying factor or dimension being tested. The index used is the correlation between the item and the total score minus the score of the item being correlated. High item-total correlations indicate a strong relationship or that the item is measuring the same thing as the whole scale. Low item-total correlations indicate weak or no relationship, and, therefore, this item measures something different from the rest of the scale. A minimum requirement for a scale is that each item correlate with the sum of the other items positively, or to a significant degree. If the value is close to 1, it represents perfect reliability.

All the methodologies discussed here will be shown in the output file "results" later. This chapter is a preparation for you to understand all the computations and explanations in this program.

3. DEVELOPMENT OF THE COMPUTER PROGRAM

The program *atmeas* (short for *atmeas.f*) has the capacity for up to 26 items (A to Z) and 999 persons. If more than 26 items are indicated, the program only processes the first 26 items. If more than 999 persons are used, the program only processes the first 999 persons. Operation is not terminated in these cases. Each item may have a maximum of nine categories, coded 1 through 9. Either of these extremes may represent an extremely positive or an extremely negative response.

The program is designed to measure only one factor or underlying dimension. Responses to items can be either dichotomized or on a pseudo-interval scale. Likert tradition is accepted, but also some other measurements are accepted.

A full listing of the program can be found in *Appendix D*.

3.1. Setting-Up the Data File

Before any calculation can begin, the data need to be in proper order. Preparing data for analysis is the basic and crucial step in the program. You need to transfer the information from your answer sheets into a computer file. A computer file can be retrieved whenever you need to and can be easily corrected. To run the program, we need a data file which contains all the information you want to analyze. At least one input data file is needed from the user of the program. You can use the program anytime as long as you have a default data set. Since this program is developed under the consideration of wide usage, the user **must** follow certain instructions and format to construct your data file (see *Appendix A*). It is formed as simply as possible, and users

of all levels should be able to create the data file easily. Use will get easier after practicing a couple of times.

The data file can be treated as having two parts. Row 1 through row 5 are recognized as the first part, containing all the important parameters for the analysis. The second part starts from row 6 to the end of data file, containing the individual's response data for all the respondents. *Appendix A* has condensed instructions for entering the control parameters and the individual's response data. With an example, it should be used as a reference guide whenever you want to set up the data file. In what follows, I will explain the procedures step by step. You need to check the forms for legibility and completeness before entering data into the computer file. You can modify the data file whenever you want to, putting more items into the data set or adding more respondents' records to it.

The first five rows of the data set are somewhat different from the rest of the rows (see the following examples). They give all the important parameters to the program to read first. The first row contains the number of participants and the number of selected participants in the data file. The second row contains the number of variables in the data file. The third row contains the maximum score used in the data file. All the variables must have the same kind of format and the same maximum score. The fourth row tells you which item needs to be reversed in its direction. The program will not change the direction for the variable if it reads zero, while it will change the direction for the variable when it reads one. The fifth row contains the dichotomization cutting points (see page 8 above). The user selects the cutting points in the fifth row of

the data file. The program then employs the user supplied cutting points to do the dichotomization for the dichotomous analysis. The responses answered in Likert format or other multi-level format in the data file will then be replaced by 0 and 1. The dichotomization point is indicated by the highest response value recoded as 0. From the sixth line on, you will feel more familiar as the format is more commonly carried in other data files. Each row should consist of one respondent's record led by the three-digit identification number for each person. In this program, we always use *SEX* as the first variable. There are only two numbers valid in this entry, zero or one. It automatically translates the number zero to the character "M" which indicates "Male", and translates the number one to "F" which indicates "Female", in the printout file to make them more readable to people other than the analyst. If there is no *SEX* variable in your analysis, you just put zero for all persons and ignore the *SEX* information from the output file. But remember, you never leave the second entry empty or put numbers other than zero, because, if you do so, the computer will read the records as invalid records. Following the *SEX* variable, put in the item responses in the next entries (single digit, separated by comma, one row for each respondent). The computer automatically names these variables as A, B, C, etc., up to Z, i.e., up to 26 items.

In *Example 1*, we use a real data set — *data1* from Dr. Spade's research data analysis. We select the first part of the data file with 5 respondents for the purpose of illustration:

```

100, 100
8
5
0, 0, 0, 0, 0, 0, 0, 0

```

3, 3, 3, 3, 3, 3, 3, 3
001, 0, 3, 1, 2, 4, 3, 5, 5, 5
002, 0, 2, 2, 3, 3, 4, 4, 3, 4
003, 0, 1, 2, 1, 5, 5, 5, 5, 5
004, 1, 5, 1, 5, 5, 5, 5, 5, 5
005, 0, 4, 2, 2, 3, 4, 3, 2, 4
.....

According to the rules we discussed earlier, let us explain the first five rows (printed in bold). There is a data set with 100 respondents (first entry, first row), and the program selects 100 respondents (second entry, first row) to do the analysis. Having selected these options, any three-digit number smaller than 100 will be allowed, any number bigger than 100 will be ignored, and the program will only process the first 100 responses. There are eight variables (the second row) to be used for the analysis. Remember, any number up to 26 can be chosen. Your data file can also contain more items than you choose to analyze on a given run. For example, if you were only interested in the first 4 variables, as the illustration in Section II, you could put 4 in the second row instead of 8. The program will only process the first 4 variables. The variables have a maximum score of five (the third row), i.e., strongly disagree, disagree, uncertain, agree, strongly agree in *Example 1*. There are eight zeros in the fourth row. In this data set there is no item to be reversed, i.e., all the variables have the same direction — all 1's indicate men's fault and all 0's indicate women's fault. The reversed score matrix is the same as the original one (see output file in *Appendix C*). The 3's in the fifth row tell the program to make the dichotomization points between 3 and 4 for each item; i.e., numbers equal or smaller than 3 (1, 2, and 3, in this example) will be changed to 0, numbers greater than 3 (4 and 5 in this example) will be changed to 1.

From the sixth row, following the identification number (first three-digits) and *SEX* variable (second entry), there are up to 26 entries left for the variables you need to analyze (8 variables in this example).

To provide another illustration, a simulated hypothetical data set — *data2* is presented. The beginning part of the data file with the first 5 respondents' answers are as follows:

```
20, 20
4
9
0, 1, 0, 1
4, 4, 3, 3
001, 0, 1, 9, 2, 8
002, 1, 7, 3, 4, 6
003, 0, 5, 5, 3, 6
004, 0, 6, 4, 4, 4
005, 1, 3, 7, 4, 6
.....
```

This data set has 20 participants (first entry, first row), and the program will pick up all 20 participants (second entry, first row) for data analysis. There are four variables (the second row) with a maximum a score of nine (the third row) — the largest one we can use from this program. The fourth row of the data file, “0, 1, 0, 1”, means that the direction of the first and third variables (items A and C) stays the same as it was and the direction of the second and the fourth variables (items B and D) needs to be reversed before doing any significant calculation. After processing, the reversed score data set is different from the original score matrix. The fifth row, “4, 4, 3, 3”, tells the program to dichotomize variables A and B between the responses 4 and 5, and to dichotomize variables C and D between 3 and 4.

3.2. Executing the Program

There is no need to talk about getting access to the computer here. Once the data file is set correctly, you just need to give the system some simple commands (*Appendix B* explains this) and the program does the rest. You need to tell the computer which program you want to use for analysis. Once the program has been entered into the computer, for example, for this program, we type “f77 atmeas.f” to tell the computer that we want to use *FORTRAN77* language. We have a *FORTRAN* program file named atmeas.f to do the particular analysis. f77 is short for *FORTRAN77*. atmeas.f is the program’s file name. atmeas stands for attitude measurements. The extension *f* stands for *FORTRAN*. It tells the computer it is a *FORTRAN* program. (The above command was done by the programmer for compiling purposes, not for people who will use the program.) You don’t have to know much about computers to use it, but you do have to know how to run jobs on the particular computer. This program is a tool which contains many internal commands to complete the analyses. The user only needs to type one or two simple commands and the results will come out. That is, you instruct your computer to turn these commands over to the program for processing.

After giving the computer your data file, one output file will automatically come out with results as the output file name (see *Appendix C*). You may give names other than results after executing the program if you have several data files to compute at once. Otherwise the output file results of the second data set will override the results file of the first one and so forth. If you have one data file, but would like to make a comparison by selecting a different number of participants or a different number of variables at once,

you need to keep a copy of what you have done. You must copy the results to another file name.

3.3. The Guide to Program Output and Explanation of the Analyses

Here is an outline of the output:

Control Parameters.

Original Score Matrix (Individual responses before item reversed).

Reversed Score Matrix (Individual responses and total score after item reversed)

SECTION I. Summary Statistics

Frequencies for each Scale Item

Percentages for each Scale Item

Mean

Standard Deviation

Variance

SECTION II. Analysis of Dichotomized Responses

A. The Dichotomized Score Matrix

(Including Total Score and Cutting Points)

B. Frequencies for the Dichotomized Score

C. Percentages for the Dichotomized Score

- D. Guttman Score Matrix
- E. Green Index of Consistency
- F. Reduced Guttman Score Matrix
(Including Guttman score type and error counting)
- G. The Guttman Coefficient of Reproducibility
(Including Reproducibility Index)
- H. Kuder-Richardson Formula 20
- I. Inferred Average Inter-Item Correlation

SECTION III. Analysis of Multilevel Responses

- A. Inter-Item Covariance Matrix
- B. Pearson Product-Moment Correlation Matrix
- C. Item-total Correlation Matrix
- D. Kuder-Richardson Formula 20
- E. Inferred Average Inter-Item Correlation

You will understand the discussion that follows better if you continually look back to the examples given in *Appendix C*.

The first part of the output lists the control parameters. It gives the general information about the data set: number of participants, number of selected participants, number of variables, the maximum score used, valid responses, invalid responses, and

the item(s) which need to be reversed. This information is needed throughout the program.

Following the above information is the “*Original Score Matrix*.” The original score matrix has eliminated any invalid response from the data file. In the first data set shown in *Appendix C*, from the sixth row on, any item response larger than five is an invalid response. The record for person 050 is invalid since there are nines in items A, B, C, E, F, and G. The 070 record is also invalid since there are nines for items C and E. They are invalid because the supposed maximum number for the answers should be five. The number of valid respondents has dropped from 100 to 98 (see *results* file for the *data1* in *Appendix C*). In the second data set — *data2*, any number over nine or smaller than 1 is recognized as an invalid response by the program. The 006 response, for example, is invalid. The 018 response containing a zero in item A is also invalid. The total valid respondents will then be dropped from 20 to 18 (see the *results* file for *data2* in *Appendix C*). To see if the “*Original Score Matrix*” in the output is to be a copy of the data file, it depends on how well the data file is constructed. If there are no missing values or no invalid data, they should have the same number of respondents and same number of variables. These numbers are also good for comparing the differences between the original matrix and the reversed one.

The “*Reversed Score Matrix*” is based on the original score matrix. Before going to the summary, we need to find out which items are going to be reversed so that all items will be scored in the same attitudinal direction. Therefore, variables are classified into different categories based on the coding scheme. This makes all items in the same

direction instead of two different ones, i.e., the bigger number represents the positive answer and smaller number represents the negative answer. This is the right time and the only chance to do this. This step is to insure all analyses below this point will be a valid analysis. This procedure is required only when there are some items needing to be reversed. Otherwise, fill the fourth line of the data file with only zeros. A zero indicates that this item is to remain unchanged (these items are called OVERTSE) and a one indicates that this item needs to be reversed (these items are called REVERSE). The “*Original Score Matrix*” can be compared with the matrix in the data file. The “*Reversed Score Matrix*” shows the data after reversing. For the “*Reversed Score Matrix*,” each person’s total score is also recorded. The total score is a summation of scored items for each person, each item being keyed so that a higher value is equivalent to having more of the attitude. The last line of the matrix is the sum of the scores for each item. This is used in the analysis of multilevel responses. The total is a summation of scored responses to each item, where each item has been keyed so that a higher value is equivalent to having more of the underlying attribute in question. The major criteria here for evaluating a scale is its internal consistency or homogeneity of items.

The two matrices serve each other and give us a very nice appearance of the data set. It also helps to give an overview of what we are doing. It is nice to have them just before doing the statistics, though it is not necessary.

(1). Summary Statistics

The first section of the statistical results deals with typical descriptive statistics.

It does the summary statistics describing the data: the frequencies for each item, the percentages for each item, the item means, standard deviations and variances, as well as the total score's mean, standard deviation and variance. (The last three figures will later provide some of the necessary steps for the calculation of an index of reliability for multilevel responses.)

The first part of the summary statistics presents the frequency of each category of items. The frequency shows how many people chose particular categories. There are five categories in data1 and nine categories in data2. For each item, the total frequency should be the number of selected and valid participants. The percentage is just another form of the frequency. It multiplies the frequency and the number of selected and valid participants, then takes its percentage. Sometimes, it can aid the researcher in the selection of appropriate dichotomization points to just glance at the table. The greater the spread of the scores, the more potential there is for obtaining individual differences. The potential is reflected by the distribution of responses to each item and/or the variability of the item. The line labeled "total" exists as a check on the number of respondents considered in the analysis. It tabulates the sum of the category frequencies per item.

The mean is the average of each variable. It shows the central tendency for the data we analyze and the typicalness. But the mean ignores some information about the variables, especially if there are cases that have values much larger or smaller than others. When this is the case, this measurement will not be a good measure of central

tendency. It is unduly influenced by those extreme values. Measures of central tendency provide information only about “typical” value. They tell you nothing about how much the values vary within the sample. The number of categories and the mean of the item will affect the size of the standard deviation and variance and measures of variability. A large value of the variance tells you that the values are quite spread out, a small value indicates that the responses are pretty similar. The greater the potential differentiation on each item, the greater the possibility of accurately differentiating persons within the sample on their different attitudes, traits, or whatever is being measured. To express the variability in the same units as the observation, we take the square root of the variance. This is called the standard deviation. The variance and standard deviation measure the extent to which a distribution spreads out from its mean.

The mean, standard deviation, variance, and the multilevel distribution of responses, provide one of the more valuable sources of information regarding the way in which the items in the scale reflect the characteristics of the respondents, as well as the potential worth of each item. The above analyses have little to do with the internal consistency or single factoredness of the scale. The characteristics will be very helpful for the next steps in the computations.

(2). Analysis of Dichotomized Responses

The second section of the statistical results is analyses of dichotomized variables, mainly Guttman Scale Analysis and the related Green Index of Consistency. Kuder-Richardson formula 20 reliability and the inferred average inter-item correlations are also

provided as alternative indices of internal consistency. The major criteria for evaluating a scale is its internal consistency, homogeneity, or reproducibility of items.

Guttman Scalogram Analysis is chosen for this purpose. It has become popular among social scientists. It includes a discussion on the derivation of total scores, ideal scale types, and various error counting methods. While originally, Guttman Scale Analyses occasionally employed multi-level responses, in practice, dichotomized items are usually used and are what is employed here.

A) The first stage in the Guttman Scalogram Analysis is to prepare the dichotomized score matrix. Items that are coded in reversed direction are first transformed and then dichotomized. Here is the principle for selecting the cutting points: When each item is dichotomized, one (1) is equivalent to possessing more of the attribute being measured, zero (0) is equivalent to possessing less of the attribute. Each individual receives a pattern of 1's and 0's to represent his responses to items in the whole scale. The analyst had the flexibility of determining the cutting points separately for each variable by writing the points in the data file. A new pattern of responses can be obtained after the dichotomizing procedure. We can get the total score of each person and the total for each item by adding up scores of rows and columns. Each respondent is then assigned a single overall score, the bigger the score, the more positive the respondent is. For each item, a total is also computed, the bigger the value, the more positive the item is. Below the item's total, the dichotomization point is also carried out by the computer. These numbers should be a copy of the fifth row in the data file.

- B) Given the new frequency distribution table of the new dichotomized score matrix, the frequency can be counted according to the popularity. The total answer of each item should be the same, which is the total number of valid respondents as we've done in the first section. The table becomes simple because the multilevel items are transformed into dichotomized items.
- C) Given the new percentages of the new dichotomized score matrix, there is another version of the prior step (they should be consistent with each other). The total percentage of each item should be 100 percent.
- D) Forming the Guttman scale pattern according to the total score of respondents and the total of items, i.e., respondents are reordered in terms of their total scores and items in terms of their popularity. The respondents' scores go down from top to bottom. The item's popularity goes from low to high from left to right. This shows how close the data are to a triangular stair-step pattern which a perfect Guttman scale would show. The "*Reduced Guttman Score Matrix*" at output *F* below, continues the Guttman Scalogram Analyses.

Computations for Green error counting are also presented below the totals. They are based on the procedures described in Green's paper. They are presented here because of the convenience of using this Guttman scale matrix to do the calculations. These are preparations for calculating the obtained and chance reproducibility. The row labeled *TOTAL* is n_g in the formula discussed in the prior chapter (see *page 13*). The row labeled *NON-TOT* is n_g in the formula. The row labeled *NO 1,0* is $n_{g+1, g}$ in the

formula. The row labeled $NO\ 1,1,0$ is $n_{g+2,\ g+1,\ g,\ g-1}$ in the formula. The row labeled $NO\ 1,x,0$ is $n_{g+2,\ g}$ in the formula. Further calculations for Green B index of consistency will be done in the output E .

- (E) The Green B reproducibility and the chance reproducibility are given out before the Green B index of consistency since they are the necessary steps. The Green B index is based on these two values. If the index is below 0.5, as a suggested minimum measure of scalability, the message "This set of items is not scalable" will be printed following the value of the index of consistency, as in the results file for *Example 1* in *Appendix C*.
- (F) The Guttman scalogram is displayed in a somewhat different manner than the original Guttman score matrix in output D . The total score (labeled TOT) for each respondent is given next to the last item of each respondent as it did in output D . In this display, every type of response occurring in the original matrix is displayed, but instead of repeating the response pattern as many times as it occurs, it is presented only once and is followed by its frequency (labeled FRQ) of occurrence, i.e., the same type of responses is combined into a single line. Identical patterns are not repeated but are tabulated in the frequency count. One loses specificity in identifying each respondent by using this technique, but the rank ordering of respondents, the essential information, is not only preserved but also condensed. This technique is especially useful for a large number of respondents (as in *Example 1*). Next to the FRQ is a vector labeled ERR . It

tabulates the number of errors of this particular type. The error(s) multiplied by the corresponding frequency (the prior entry of the same row) yields the total error, which is the Guttman error used to calculate the coefficient of reproducibility in the next output *G*. The last entry of the matrix, called *TYP*, indicates the ideal response pattern that any particular pattern most closely approximates. There are two conditions for making this judgment. The first one involves the minimization of error and the second one is concerned with the frequency of occurrence of the ideal response patterns which minimize error. The non-scale type response patterns thus can be replaced within the scalogram without ambiguity. If there is more than one ideal response type satisfying the minimum error criterion, the program picks up the one which has the least errors. If they have the same number of errors, the program always gives the ideal type to the one which has the largest frequency. If they have the same frequency, the program always gives the higher number ideal type to the non-scale one. All the ideal types will be printed even though in some analyses there might be no cases for some ideal types. The last entry of output *F* prints out the types our computer picked out according to the above rules. The ideal types are printed with a * in front of the row.

- (G) The Guttman error is used to calculate the coefficient of reproducibility. The number of items and number of respondents are also needed. The total responses are obtained by multiplying the number of items and the number of respondents. The total errors are the total deviations from the ideal pattern — the number of

times participants' choices fell outside of the predicted pattern of responses for these assigned ideal types. Any value of the coefficient above 85% was considered by Guttman as a good practical ideal for a unidimensional domain of items.

- (H) Kuder-Richardson formula 20 reliability needs the information about the sum of item variances and the total score variances. For each item, if using P as the probability of getting a 1, Q is $1-P$, then the variance of a dichotomous item is $P * Q$ (look at output C for better understanding). The total variance is the variance of the respondents' total scores. The two numbers, sum of item variance and total variance, are printed out before the K-R20 (thereby enabling the user to calculate this value for himself). It gives you a better understanding and good check for the formula. The index should be close to 1 if there is perfect internal consistency and single factoredness. Higher values for K-R imply that respondents maintained a consistent position relative to the mean of each item and to the position of their total score.
- (I) Based on the output H , the inferred average inter-item correlation is easily derived with other information obtained before. A higher number indicates strong bonding among each item, usually a good measuring instrument. A lower number indicates weak bonding among each item, a sign of a bad measuring instrument.

Section II of the output file prints out all the information discussed above.

(3). Analysis of Multilevel Responses

The third section of the output represents analysis indices associated with the multilevel responses, as in the Likert tradition (such as: Strongly Agree, Agree, Uncertain, Disagree, Strongly Disagree) used in data1.

Reliability is the fundamental issue in psychological measurement. Dichotomized items do not use all of the information, and the inter-item correlations and reliability coefficients are usually restricted to values below 1.00, even with the most consistent respondents. Multi-level scores do not entirely eliminate these problems but they do reduce them to trivial proportions. In this section, the following computations are done:

- (A) Forming the covariance matrix. This consists of variances of all items as diagonal terms and covariances of all pairs as off-diagonal terms. This covariance matrix represents the unstandardized relationship between variable pairs.
- (B) Forming the standardized correlation matrix from the covariance matrix. The relationships between variable pairs are expressed by standardized covariances, that is, the Pearson Product-Moment Correlation Coefficients. All of the diagonal terms are replaced with 1, which is the highest correlation we can get. It is the correlations of each item with itself. All of the off-diagonal terms should be less than 1, but greater than -1.
- (C) The item-total correlation between each item, and the total score minus the score of the item being correlated, are presented here. A minimum requirement for a scale is that each item correlated with the sum of the other items positively, or

to a significant degree. The Pearson Product-Moment coefficients are also given out below the covariances.

- (D) Here again, we calculate K-R reliability. Because we are doing the computation for multilevel responses, the computation of the sum of item variances and total score variance are different from the one for dichotomous responses, though the formula looks the same. The numbers we used come from Section I Summary Statistics. Each item's variance is totaled as the sum of item variance. The variance of the total scores, also presented in Section I, is copied here as the denominator for the K-R reliability formula. Thus, the multilevel K-R reliability is carried out.
- (E) The computation of inferred average correlations for multi-level responses is the same as the dichotomous one. The difference is that they take different K-R reliability so that the results are different. In the *data1* example in *Appendix C*, the multi-level values are higher than those based upon dichotomized items, and this is what is usually found.

4. CONCLUSION

There are a variety of methods of attitude measurement. The program *atmeas* is an effort to make using some of these methods easier by taking advantage of the computer.

It is of particular value for users who want to use the Guttman scale technique in attitude measurement.

Each statistical test in this program is supposed to measure a single concept. The first part is a common statistical calculation of scored responses. The actual pattern of a person's responses to individual items is not important — attention is paid just to the overall summed score. The second part is mainly developed in terms of the Guttman Scale Analysis. A person's pattern of responses to items is assumed to be reproducible from his total score. Any individual who responds positively to a particular item should also have responded positively to all items of greater popularity than that particular item. Any person who passes the most difficult item should also have passed all items of lesser difficulty. The third method concentrates upon comparing the variation of responses to each item with the variance of each respondents' summed scores.

The major criteria of the first method for evaluating a scale is the internal consistency or homogeneity of items. The major criteria of the second one for evaluating scales is the extent of reproducibility of the pattern of responses to items from the total scores. The more exact the prediction of individuals' pattern of scores, the higher the reproducibility of the scales. The major criteria of the third one is the reliability of

constructed scores. Good items are those which have a high correlation with the other items in the scale and with the total score.

REFERENCES

- Burns, John A.** (1973). A manual to accompany program ATSCALE evaluation of the unidimensionality and internal consistency of responses to a series of questions. Duplicated at the Dept. of Psychology, Northwestern University.
- Dawes, Robyn M.** (1985). Attitude and opinion measurement. In G. Lindyan & E. Arrome, Handbook of social psychology. Third Edition, Vol. 1. New York: Random House, pp.509-560.
- DeVellis, Robert F.** (1991). Scale development: Theory and applications. Newbury Park, CA: Sage.
- Guttman, Louis.** (1970). A basis for scaling qualitative data. In G. G. Summers (Ed.), Attitude measurement. Chicago, IL: Rand McNally & Company, pp. 174-186. (originally published in 1944)
- Green, Bert F.** (1956). A method of scalogram analysis using summary statistics. Psychometrika, 21(1), pp.79-88.
- Nunnally, Jum C.** (1978). Psychometric theory. New York: McGraw-Hill.

APPENDIX A — Format of the Input Data File

1. Summary of input:

Data File Name: data2

2. Forming Data File Procedure: (Using *Example 2*)

Row 1:	No. of Participants, Selected Participants	20, 20
Row 2:	No. of Variables to be analyzed:	4
Row 3:	Maximum Score (1—9):	9
Row 4:	Variable Reverse Code: (0 or 1)	0, 1, 0, 1
Row 5	Dichotomization Points	4, 4, 3, 3

From Row 6 to the end of file:

ID, SEX, NVAR₁ NVAR_Z 001, 0, 1, 9, 2, 8

Explanations:

1. Space between numbers is not allowed in the data file. Rather, use a comma instead. The computer will only separate numbers by reading a comma.
2. For row 3, every variable should have the same number of response categories.
3. For row 4, variables that stay the same direction are coded as **0**, variables that need to be reversed are coded as **1**. The number of entries in this row should be the same as the number of the variables in row 2.
4. For row 5, the dichotomization points, use the highest score to be given the value 0.
5. For rows 6 and following, enter one person's identification number (three-digits) followed by a comma, sex (0=male, 1=female) followed by a comma, then responses to items A, B, etc., to Z, with a comma between each item.

APPENDIX B — Execution Procedure

You are more than welcome to learn how to use the CS1 operating system. It will make work with this program much easier. But if you are not familiar with it, just follow the steps below and try to get help from the consultant in the computing center.

In the CS1 system:

1. Creating the data file.

- a. type “**emacs data**” (instead of data, some other names within eight-digits may be used).
- b. input data — following the format described in *Appendix A*,
- c. press “Ctrl-X-C” for saving and exiting after having all the data put into the file.

If modifying is desired, repeat the above steps.

2. **Submit** the data file by typing “**a.out,**” then under the message “Please Enter Data File Name:” give the data file name (e.g., data1 or data2 for the illustrations in text and *Appendix C*).
3. Then **open and read the output file** by typing the command “**more results**” (this is the output file named by the program).
4. To **get a print out**, type “**printfile results**” and make selections for the appearance of the output file. Get the hard copy from the bin.
5. **Option:** Download the file to PC if desired by typing “**download filename.**” following the instructions, you do the rest.

NOTE:

1. One must use **lowercase** when typing these commands.
2. Step 2 depends on Step 1, i.e., you need to submit the data file first.
3. All the italic-underlined letters can be replaced by your own choice of filename.

APPENDIX C — Two Example Data Files and Output Files

C.1. Example 1: Data File — *data1*

```
100, 100
8
5
0, 0, 0, 0, 0, 0, 0, 0
3, 3, 3, 3, 3, 3, 3, 3
001, 0, 3, 1, 2, 4, 3, 5, 5, 5
002, 0, 2, 2, 3, 3, 4, 4, 3, 4
003, 0, 1, 2, 1, 5, 5, 5, 5, 5
004, 1, 5, 1, 5, 5, 5, 5, 5, 5
005, 0, 4, 2, 2, 3, 4, 3, 2, 4
006, 1, 3, 3, 3, 4, 4, 5, 3, 3
007, 0, 2, 3, 4, 5, 5, 5, 5, 4
008, 0, 1, 2, 4, 4, 4, 2, 4, 3
009, 0, 3, 1, 5, 5, 5, 5, 5, 3
010, 0, 4, 2, 4, 5, 5, 4, 5, 5
011, 1, 2, 2, 2, 3, 5, 4, 5, 4
012, 0, 3, 3, 4, 4, 4, 4, 5, 5
013, 1, 1, 2, 4, 5, 5, 4, 5, 5
014, 0, 2, 1, 3, 5, 5, 5, 3, 4
015, 0, 3, 5, 3, 5, 4, 3, 2, 2
016, 1, 5, 3, 5, 5, 5, 5, 5, 5
017, 0, 4, 1, 2, 5, 5, 5, 5, 4
018, 0, 3, 2, 5, 5, 5, 3, 4, 5
019, 1, 3, 5, 4, 4, 5, 5, 5, 5
020, 0, 4, 2, 4, 4, 4, 4, 5, 4
021, 1, 3, 4, 4, 5, 5, 5, 5, 5
022, 1, 5, 3, 5, 5, 5, 4, 4, 5
023, 0, 2, 2, 1, 5, 3, 4, 4, 4
024, 1, 3, 2, 1, 2, 3, 4, 3, 3
025, 0, 3, 3, 1, 2, 2, 2, 1, 1
026, 1, 1, 2, 5, 5, 5, 5, 4, 5
027, 0, 3, 3, 2, 3, 2, 4, 3, 5
028, 1, 5, 1, 4, 5, 5, 5, 5, 5
029, 1, 3, 1, 3, 5, 5, 5, 5, 5
030, 1, 4, 2, 5, 5, 5, 4, 5, 4
031, 1, 2, 1, 4, 5, 5, 2, 5, 5
032, 1, 2, 3, 3, 5, 4, 5, 3, 5
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033, 1, 3, 2, 2, 5, 4, 4, 5, 5
034, 1, 3, 2, 4, 5, 4, 4, 4, 4
035, 1, 2, 4, 2, 5, 5, 4, 3, 5
036, 1, 3, 1, 1, 4, 2, 4, 2, 5
037, 1, 1, 2, 3, 5, 5, 4, 5, 5
038, 0, 4, 1, 5, 5, 5, 5, 5, 5
039, 1, 3, 1, 3, 5, 2, 5, 3, 5
040, 0, 3, 2, 5, 5, 5, 4, 4, 5
041, 0, 3, 2, 5, 5, 5, 4, 3, 4
042, 1, 2, 1, 3, 4, 5, 5, 5, 5
043, 1, 2, 2, 4, 5, 5, 5, 5, 5
044, 1, 4, 2, 2, 5, 5, 5, 5, 1
045, 1, 4, 1, 2, 5, 4, 4, 5, 3
046, 1, 3, 2, 5, 5, 5, 5, 5, 5
047, 1, 2, 1, 3, 5, 5, 5, 5, 5
048, 1, 2, 4, 5, 5, 5, 5, 5, 5
049, 0, 1, 1, 5, 5, 5, 3, 4, 5
050, 0, 9, 9, 9, 5, 9, 9, 9, 4
051, 1, 3, 1, 5, 5, 5, 5, 5, 5
052, 1, 3, 4, 2, 5, 4, 5, 5, 4
053, 1, 3, 3, 3, 5, 4, 4, 5, 4
054, 1, 1, 3, 2, 5, 5, 5, 1, 1
055, 0, 3, 4, 4, 2, 5, 5, 5, 5
056, 0, 2, 2, 3, 4, 4, 3, 4, 2
057, 1, 5, 1, 5, 5, 5, 5, 4, 4
058, 0, 3, 4, 4, 4, 4, 4, 5, 5
059, 1, 4, 3, 5, 5, 5, 5, 5, 5
060, 1, 4, 1, 5, 5, 5, 5, 5, 5
061, 0, 4, 2, 2, 5, 5, 5, 5, 5
062, 0, 4, 5, 2, 1, 5, 4, 2, 2
063, 0, 3, 1, 1, 2, 4, 3, 3, 2
064, 1, 4, 4, 3, 4, 5, 5, 4, 5
065, 1, 3, 4, 5, 5, 4, 5, 5, 5
066, 1, 4, 1, 5, 5, 5, 5, 5, 5
067, 0, 2, 1, 2, 4, 4, 4, 3, 4
068, 0, 4, 1, 4, 5, 4, 4, 4, 4
069, 0, 5, 1, 5, 5, 5, 5, 5, 5
070, 1, 4, 3, 9, 5, 9, 5, 5, 5
071, 0, 3, 2, 5, 5, 4, 4, 3, 5
072, 1, 4, 4, 4, 5, 5, 5, 2, 5
073, 1, 3, 3, 5, 5, 3, 4, 5, 4
074, 0, 1, 1, 2, 4, 5, 4, 3, 4
075, 0, 3, 1, 4, 1, 3, 3, 2, 5

076, 0, 4, 3, 4, 5, 5, 5, 3, 5
 077, 0, 2, 1, 4, 5, 4, 3, 4, 4
 078, 0, 4, 2, 4, 4, 1, 5, 3, 3
 079, 0, 1, 1, 5, 1, 4, 3, 5, 3
 080, 0, 4, 5, 3, 5, 4, 5, 5, 5
 081, 1, 3, 5, 4, 4, 5, 4, 4, 5
 082, 0, 4, 2, 5, 5, 5, 5, 5, 5
 083, 1, 2, 2, 4, 2, 4, 4, 4, 3
 084, 1, 3, 3, 4, 5, 5, 5, 4, 5
 085, 0, 1, 1, 3, 5, 3, 5, 4, 4
 086, 1, 3, 1, 4, 5, 5, 5, 5, 5
 087, 1, 4, 3, 5, 5, 5, 4, 5, 4
 088, 1, 3, 2, 5, 4, 5, 4, 4, 4
 089, 1, 4, 1, 5, 5, 5, 5, 5, 5
 090, 1, 2, 2, 4, 5, 5, 5, 5, 5
 091, 1, 5, 2, 4, 5, 5, 5, 4, 5
 092, 1, 4, 3, 2, 5, 5, 5, 5, 5
 093, 1, 3, 2, 3, 5, 5, 5, 5, 5
 094, 1, 3, 3, 5, 5, 5, 5, 5, 5
 095, 0, 4, 3, 2, 5, 5, 5, 4, 3
 096, 1, 5, 3, 5, 5, 5, 5, 5, 5
 097, 1, 3, 2, 2, 5, 5, 5, 5, 5
 098, 1, 3, 1, 5, 5, 5, 5, 5, 5
 099, 0, 5, 1, 4, 5, 5, 5, 5, 4
 100, 1, 4, 1, 5, 5, 5, 5, 5, 5

C.2. Example of output for data1:

* * * * * INPUT INFORMATION * * * * *

CONTROL PARAMETERS:

Number of Participants = 100

Selected Participants = 100

Number of Variables = 8

Maximum Score = 5

No. of Valid Respondents = 98

No. of Invalid Respondents = 2

Items to be Reversed: None

* * * * * ORIGINAL SCORE MATRIX * * * * *

ID	SEX	A	B	C	D	E	F	G	H	TOT
001	M	3	1	2	4	3	5	5	5	28
002	M	2	2	3	3	4	4	3	4	25
003	M	1	2	1	5	5	5	5	5	29
004	F	5	1	5	5	5	5	5	5	36
005	M	4	2	2	3	4	3	2	4	24
006	F	3	3	3	4	4	5	3	3	28
007	M	2	3	4	5	5	5	5	4	33
008	M	1	2	4	4	4	2	4	3	24
009	M	3	1	5	5	5	5	5	3	32
010	M	4	2	4	5	5	4	5	5	34
011	F	2	2	2	3	5	4	5	4	27
012	M	3	3	4	4	4	4	5	5	32
013	F	1	2	4	5	5	4	5	5	31
014	M	2	1	3	5	5	5	3	4	28
015	M	3	5	3	5	4	3	2	2	27
016	F	5	3	5	5	5	5	5	5	38
017	M	4	1	2	5	5	5	5	4	31
018	M	3	2	5	5	5	3	4	5	32
019	F	3	5	4	4	5	5	5	5	36
020	M	4	2	4	4	4	4	5	4	31
021	F	3	4	4	5	5	5	5	5	36
022	F	5	3	5	5	5	4	4	5	36
023	M	2	2	1	5	3	4	4	4	25
024	F	3	2	1	2	3	4	3	3	21
025	M	3	3	1	2	2	2	1	1	15
026	F	1	2	5	5	5	5	4	5	32
027	M	3	3	2	3	2	4	3	5	25
028	F	5	1	4	5	5	5	5	5	35
029	F	3	1	3	5	5	5	5	5	32

030	F	4	2	5	5	5	4	5	4	34
031	F	2	1	4	5	5	2	5	5	29
032	F	2	3	3	5	4	5	3	5	30
033	F	3	2	2	5	4	4	5	5	30
034	F	3	2	4	5	4	4	4	4	30
035	F	2	4	2	5	5	4	3	5	30
036	F	3	1	1	4	2	4	2	5	22
037	F	1	2	3	5	5	4	5	5	30
038	M	4	1	5	5	5	5	5	5	35
039	F	3	1	3	5	2	5	3	5	27
040	M	3	2	5	5	5	4	4	5	33
041	M	3	2	5	5	5	4	3	4	31
042	F	2	1	3	4	5	5	5	5	30
043	F	2	2	4	5	5	5	5	5	33
044	F	4	2	2	5	5	5	5	1	29
045	F	4	1	2	5	4	4	5	3	28
046	F	3	2	5	5	5	5	5	5	35
047	F	2	1	3	5	5	5	5	5	31
048	F	2	4	5	5	5	5	5	5	36
049	M	1	1	5	5	5	3	4	5	29
051	F	3	1	5	5	5	5	5	5	34
052	F	3	4	2	5	4	5	5	4	32
053	F	3	3	3	5	4	4	5	4	31
054	F	1	3	2	5	5	5	1	1	23
055	M	3	4	4	2	5	5	5	5	33
056	M	2	2	3	4	4	3	4	2	24
057	F	5	1	5	5	5	5	4	4	34
058	M	3	4	4	4	4	4	5	5	33
059	F	4	3	5	5	5	5	5	5	37
060	F	4	1	5	5	5	5	5	5	35
061	M	4	2	2	5	5	5	5	5	33
062	M	4	5	2	1	5	4	2	2	25
063	M	3	1	1	2	4	3	3	2	19
064	F	4	4	3	4	5	5	4	5	34
065	F	3	4	5	5	4	5	5	5	36
066	F	4	1	5	5	5	5	5	5	35
067	M	2	1	2	4	4	4	3	4	24
068	M	4	1	4	5	4	4	4	4	30
069	M	5	1	5	5	5	5	5	5	36
071	M	3	2	5	5	4	4	3	5	31
072	F	4	4	4	5	5	5	2	5	34
073	F	3	3	5	5	3	4	5	4	32
074	M	1	1	2	4	5	4	3	4	24

075	M	3	1	4	1	3	3	2	5	22
076	M	4	3	4	5	5	5	3	5	34
077	M	2	1	4	5	4	3	4	4	27
078	M	4	2	4	4	1	5	3	3	26
079	M	1	1	5	1	4	3	5	3	23
080	M	4	5	3	5	4	5	5	5	36
081	F	3	5	4	4	5	4	4	5	34
082	M	4	2	5	5	5	5	5	5	36
083	F	2	2	4	2	4	4	4	3	25
084	F	3	3	4	5	5	5	4	5	34
085	M	1	1	3	5	3	5	4	4	26
086	F	3	1	4	5	5	5	5	5	33
087	F	4	3	5	5	5	4	5	4	35
088	F	3	2	5	4	5	4	4	4	31
089	F	4	1	5	5	5	5	5	5	35
090	F	2	2	4	5	5	5	5	5	33
091	F	5	2	4	5	5	5	4	5	35
092	F	4	3	2	5	5	5	5	5	34
093	F	3	2	3	5	5	5	5	5	33
094	F	3	3	5	5	5	5	5	5	36
095	M	4	3	2	5	5	5	4	3	31
096	F	5	3	5	5	5	5	5	5	38
097	F	3	2	2	5	5	5	5	5	32
098	F	3	1	5	5	5	5	5	5	34
099	M	5	1	4	5	5	5	5	4	34
100	F	4	1	5	5	5	5	5	5	35

TOTAL 300 215 353 439 438 432 414 425

* * * * * REVERSED SCORE MATRIX * * * * *

ID	SEX	A	B	C	D	E	F	G	H	TOT
001	M	3	1	2	4	3	5	5	5	28
002	M	2	2	3	3	4	4	3	4	25
003	M	1	2	1	5	5	5	5	5	29
004	F	5	1	5	5	5	5	5	5	36
005	M	4	2	2	3	4	3	2	4	24
006	F	3	3	3	4	4	5	3	3	28
007	M	2	3	4	5	5	5	5	4	33

008	M	1	2	4	4	4	2	4	3	24
009	M	3	1	5	5	5	5	5	3	32
010	M	4	2	4	5	5	4	5	5	34
011	F	2	2	2	3	5	4	5	4	27
012	M	3	3	4	4	4	4	5	5	32
013	F	1	2	4	5	5	4	5	5	31
014	M	2	1	3	5	5	5	3	4	28
015	M	3	5	3	5	4	3	2	2	27
016	F	5	3	5	5	5	5	5	5	38
017	M	4	1	2	5	5	5	5	4	31
018	M	3	2	5	5	5	3	4	5	32
019	F	3	5	4	4	5	5	5	5	36
020	M	4	2	4	4	4	4	5	4	31
021	F	3	4	4	5	5	5	5	5	36
022	F	5	3	5	5	5	4	4	5	36
023	M	2	2	1	5	3	4	4	4	25
024	F	3	2	1	2	3	4	3	3	21
025	M	3	3	1	2	2	2	1	1	15
026	F	1	2	5	5	5	5	4	5	32
027	M	3	3	2	3	2	4	3	5	25
028	F	5	1	4	5	5	5	5	5	35
029	F	3	1	3	5	5	5	5	5	32
030	F	4	2	5	5	5	4	5	4	34
031	F	2	1	4	5	5	2	5	5	29
032	F	2	3	3	5	4	5	3	5	30
033	F	3	2	2	5	4	4	5	5	30
034	F	3	2	4	5	4	4	4	4	30
035	F	2	4	2	5	5	4	3	5	30
036	F	3	1	1	4	2	4	2	5	22
037	F	1	2	3	5	5	4	5	5	30
038	M	4	1	5	5	5	5	5	5	35
039	F	3	1	3	5	2	5	3	5	27
040	M	3	2	5	5	5	4	4	5	33
041	M	3	2	5	5	5	4	3	4	31
042	F	2	1	3	4	5	5	5	5	30
043	F	2	2	4	5	5	5	5	5	33
044	F	4	2	2	5	5	5	5	1	29
045	F	4	1	2	5	4	4	5	3	28
046	F	3	2	5	5	5	5	5	5	35
047	F	2	1	3	5	5	5	5	5	31
048	F	2	4	5	5	5	5	5	5	36
049	M	1	1	5	5	5	3	4	5	29
051	F	3	1	5	5	5	5	5	5	34

052	F	3	4	2	5	4	5	5	4	32
053	F	3	3	3	5	4	4	5	4	31
054	F	1	3	2	5	5	5	1	1	23
055	M	3	4	4	2	5	5	5	5	33
056	M	2	2	3	4	4	3	4	2	24
057	F	5	1	5	5	5	5	4	4	34
058	M	3	4	4	4	4	4	5	5	33
059	F	4	3	5	5	5	5	5	5	37
060	F	4	1	5	5	5	5	5	5	35
061	M	4	2	2	5	5	5	5	5	33
062	M	4	5	2	1	5	4	2	2	25
063	M	3	1	1	2	4	3	3	2	19
064	F	4	4	3	4	5	5	4	5	34
065	F	3	4	5	5	4	5	5	5	36
066	F	4	1	5	5	5	5	5	5	35
067	M	2	1	2	4	4	4	3	4	24
068	M	4	1	4	5	4	4	4	4	30
069	M	5	1	5	5	5	5	5	5	36
071	M	3	2	5	5	4	4	3	5	31
072	F	4	4	4	5	5	5	2	5	34
073	F	3	3	5	5	3	4	5	4	32
074	M	1	1	2	4	5	4	3	4	24
075	M	3	1	4	1	3	3	2	5	22
076	M	4	3	4	5	5	5	3	5	34
077	M	2	1	4	5	4	3	4	4	27
078	M	4	2	4	4	1	5	3	3	26
079	M	1	1	5	1	4	3	5	3	23
080	M	4	5	3	5	4	5	5	5	36
081	F	3	5	4	4	5	4	4	5	34
082	M	4	2	5	5	5	5	5	5	36
083	F	2	2	4	2	4	4	4	3	25
084	F	3	3	4	5	5	5	4	5	34
085	M	1	1	3	5	3	5	4	4	26
086	F	3	1	4	5	5	5	5	5	33
087	F	4	3	5	5	5	4	5	4	35
088	F	3	2	5	4	5	4	4	4	31
089	F	4	1	5	5	5	5	5	5	35
090	F	2	2	4	5	5	5	5	5	33
091	F	5	2	4	5	5	5	4	5	35
092	F	4	3	2	5	5	5	5	5	34
093	F	3	2	3	5	5	5	5	5	33
094	F	3	3	5	5	5	5	5	5	36
095	M	4	3	2	5	5	5	4	3	31

096	F	5	3	5	5	5	5	5	5	38
097	F	3	2	2	5	5	5	5	5	32
098	F	3	1	5	5	5	5	5	5	34
099	M	5	1	4	5	5	5	5	4	34
100	F	4	1	5	5	5	5	5	5	35

TOTAL 300 215 353 439 438 432 414 425

* * * * * RESULTS OF DATA ANALYSIS * * * * *

SECTION I. SUMMARY STATISTICS

A. Frequencies for Each Item

ANSWER	A	B	C	D	E	F	G	H
1	10	33	6	3	1	0	2	3
2	17	32	18	5	4	3	6	4
3	37	19	16	4	6	9	15	9
4	25	9	27	16	24	31	20	23
5	9	5	31	70	63	55	55	59
TOTAL	98	98	98	98	98	98	98	98

B. Percentages for Each Item

ANSWER	A	B	C	D	E	F	G	H
1	.10	.34	.06	.03	.01	.00	.02	.03
2	.17	.33	.18	.05	.04	.03	.06	.04
3	.38	.19	.16	.04	.06	.09	.15	.09
4	.26	.09	.28	.16	.24	.32	.20	.23
5	.09	.05	.32	.71	.64	.56	.56	.60

ITEM	MEAN	STD	VARIANCE
A	3.06	1.10	1.21

B	2.19	1.15	1.33
C	3.60	1.27	1.62
D	4.48	1.01	1.02
E	4.47	.86	.75
F	4.41	.78	.62
G	4.22	1.05	1.10
H	4.34	1.01	1.03
TOTAL	30.78	4.61	21.27

SECTION II. ANALYSIS OF DICHOTOMIZED RESPONSES

A. The Dichotomized Score Matrix

ID	SEX	A	B	C	D	E	F	G	H	TOT
001	M	0	0	0	1	0	1	1	1	4
002	M	0	0	0	0	1	1	0	1	3
003	M	0	0	0	1	1	1	1	1	5
004	F	1	0	1	1	1	1	1	1	7
005	M	1	0	0	0	1	0	0	1	3
006	F	0	0	0	1	1	1	0	0	3
007	M	0	0	1	1	1	1	1	1	6
008	M	0	0	1	1	1	0	1	0	4
009	M	0	0	1	1	1	1	1	0	5
010	M	1	0	1	1	1	1	1	1	7
011	F	0	0	0	0	1	1	1	1	4
012	M	0	0	1	1	1	1	1	1	6
013	F	0	0	1	1	1	1	1	1	6
014	M	0	0	0	1	1	1	0	1	4
015	M	0	1	0	1	1	0	0	0	3
016	F	1	0	1	1	1	1	1	1	7
017	M	1	0	0	1	1	1	1	1	6
018	M	0	0	1	1	1	0	1	1	5
019	F	0	1	1	1	1	1	1	1	7
020	M	1	0	1	1	1	1	1	1	7
021	F	0	1	1	1	1	1	1	1	7
022	F	1	0	1	1	1	1	1	1	7
023	M	0	0	0	1	0	1	1	1	4
024	F	0	0	0	0	0	1	0	0	1

025	M	0	0	0	0	0	0	0	0	0
026	F	0	0	1	1	1	1	1	1	6
027	M	0	0	0	0	0	1	0	1	2
028	F	1	0	1	1	1	1	1	1	7
029	F	0	0	0	1	1	1	1	1	5
030	F	1	0	1	1	1	1	1	1	7
031	F	0	0	1	1	1	0	1	1	5
032	F	0	0	0	1	1	1	0	1	4
033	F	0	0	0	1	1	1	1	1	5
034	F	0	0	1	1	1	1	1	1	6
035	F	0	1	0	1	1	1	0	1	5
036	F	0	0	0	1	0	1	0	1	3
037	F	0	0	0	1	1	1	1	1	5
038	M	1	0	1	1	1	1	1	1	7
039	F	0	0	0	1	0	1	0	1	3
040	M	0	0	1	1	1	1	1	1	6
041	M	0	0	1	1	1	1	0	1	5
042	F	0	0	0	1	1	1	1	1	5
043	F	0	0	1	1	1	1	1	1	6
044	F	1	0	0	1	1	1	1	0	5
045	F	1	0	0	1	1	1	1	0	5
046	F	0	0	1	1	1	1	1	1	6
047	F	0	0	0	1	1	1	1	1	5
048	F	0	1	1	1	1	1	1	1	7
049	M	0	0	1	1	1	0	1	1	5
051	F	0	0	1	1	1	1	1	1	6
052	F	0	1	0	1	1	1	1	1	6
053	F	0	0	0	1	1	1	1	1	5
054	F	0	0	0	1	1	1	0	0	3
055	M	0	1	1	0	1	1	1	1	6
056	M	0	0	0	1	1	0	1	0	3
057	F	1	0	1	1	1	1	1	1	7
058	M	0	1	1	1	1	1	1	1	7
059	F	1	0	1	1	1	1	1	1	7
060	F	1	0	1	1	1	1	1	1	7
061	M	1	0	0	1	1	1	1	1	6
062	M	1	1	0	0	1	1	0	0	4
063	M	0	0	0	0	1	0	0	0	1
064	F	1	1	0	1	1	1	1	1	7
065	F	0	1	1	1	1	1	1	1	7
066	F	1	0	1	1	1	1	1	1	7
067	M	0	0	0	1	1	1	0	1	4
068	M	1	0	1	1	1	1	1	1	7

069	M	1	0	1	1	1	1	1	1	7
071	M	0	0	1	1	1	1	0	1	5
072	F	1	1	1	1	1	1	0	1	7
073	F	0	0	1	1	0	1	1	1	5
074	M	0	0	0	1	1	1	0	1	4
075	M	0	0	1	0	0	0	0	1	2
076	M	1	0	1	1	1	1	0	1	6
077	M	0	0	1	1	1	0	1	1	5
078	M	1	0	1	1	0	1	0	0	4
079	M	0	0	1	0	1	0	1	0	3
080	M	1	1	0	1	1	1	1	1	7
081	F	0	1	1	1	1	1	1	1	7
082	M	1	0	1	1	1	1	1	1	7
083	F	0	0	1	0	1	1	1	0	4
084	F	0	0	1	1	1	1	1	1	6
085	M	0	0	0	1	0	1	1	1	4
086	F	0	0	1	1	1	1	1	1	6
087	F	1	0	1	1	1	1	1	1	7
088	F	0	0	1	1	1	1	1	1	6
089	F	1	0	1	1	1	1	1	1	7
090	F	0	0	1	1	1	1	1	1	6
091	F	1	0	1	1	1	1	1	1	7
092	F	1	0	0	1	1	1	1	1	6
093	F	0	0	0	1	1	1	1	1	5
094	F	0	0	1	1	1	1	1	1	6
095	M	1	0	0	1	1	1	1	0	5
096	F	1	0	1	1	1	1	1	1	7
097	F	0	0	0	1	1	1	1	1	5
098	F	0	0	1	1	1	1	1	1	6
099	M	1	0	1	1	1	1	1	1	7
100	F	1	0	1	1	1	1	1	1	7

TOTAL	34	14	58	86	87	86	75	82
Dichotomized								
Point	3	3	3	3	3	3	3	3

B. Frequencies for Dichotomized Score

ANSWER	A	B	C	D	E	F	G	H
0	64	84	40	12	11	12	23	16
1	34	14	58	86	87	86	75	82

C. Percentages for Dichotomized Score

ANSWER	A	B	C	D	E	F	G	H
0	.65	.86	.41	.12	.11	.12	.23	.16
1	.35	.14	.59	.88	.89	.88	.77	.84

D. The Guttman Scale Score Matrix

ID	SEX	B	A	C	G	H	D	F	E	TOT
001	M	0	1	1	1	1	1	1	1	7
002	M	0	1	1	1	1	1	1	1	7
003	M	0	1	1	1	1	1	1	1	7
004	F	0	1	1	1	1	1	1	1	7
005	M	0	1	1	1	1	1	1	1	7
006	F	0	1	1	1	1	1	1	1	7
007	M	0	1	1	1	1	1	1	1	7
008	M	1	0	1	1	1	1	1	1	7
009	M	1	1	0	1	1	1	1	1	7
010	M	1	1	1	0	1	1	1	1	7
011	F	0	1	1	1	1	1	1	1	7
012	M	0	1	1	1	1	1	1	1	7
013	F	0	1	1	1	1	1	1	1	7
014	M	1	0	1	1	1	1	1	1	7
015	M	1	1	0	1	1	1	1	1	7
016	F	0	1	1	1	1	1	1	1	7
017	M	0	1	1	1	1	1	1	1	7
018	M	1	0	1	1	1	1	1	1	7
019	F	0	1	1	1	1	1	1	1	7
020	M	1	0	1	1	1	1	1	1	7
021	F	0	1	1	1	1	1	1	1	7
022	F	0	1	1	1	1	1	1	1	7
023	M	0	1	1	1	1	1	1	1	7
024	F	0	1	1	1	1	1	1	1	7
025	M	1	0	1	1	1	1	1	1	7
026	F	0	1	1	1	1	1	1	1	7
027	M	1	0	1	1	1	1	1	1	7
028	F	0	1	1	1	1	1	1	1	7
029	F	0	1	1	1	1	1	1	1	7
030	F	0	1	1	1	1	1	1	1	7

031	F	0	0	1	1	1	1	1	1	6
032	F	0	0	1	1	1	1	1	1	6
033	F	0	1	0	1	1	1	1	1	6
034	F	0	0	1	1	1	1	1	1	6
035	F	0	0	1	1	1	1	1	1	6
036	F	0	0	1	1	1	1	1	1	6
037	F	0	0	1	1	1	1	1	1	6
038	M	0	1	1	0	1	1	1	1	6
039	F	0	1	0	1	1	1	1	1	6
040	M	1	0	1	1	1	0	1	1	6
041	M	1	0	0	1	1	1	1	1	6
042	F	0	0	1	1	1	1	1	1	6
043	F	0	0	1	1	1	1	1	1	6
044	F	0	0	1	1	1	1	1	1	6
045	F	0	0	1	1	1	1	1	1	6
046	F	0	0	1	1	1	1	1	1	6
047	F	0	0	1	1	1	1	1	1	6
048	F	0	1	0	1	1	1	1	1	6
049	M	0	0	1	1	1	1	1	1	6
051	F	0	0	1	1	1	1	1	1	6
052	F	0	0	1	1	1	1	1	1	6
053	F	0	0	0	1	1	1	1	1	5
054	F	0	1	0	1	0	1	1	1	5
055	M	0	0	0	1	1	1	1	1	5
056	M	0	0	1	1	1	1	0	1	5
057	F	0	0	1	1	1	1	1	0	5
058	M	0	0	1	0	1	1	1	1	5
059	F	0	0	0	1	1	1	1	1	5
060	F	0	0	1	1	1	1	0	1	5
061	M	0	0	0	1	1	1	1	1	5
062	M	0	1	0	1	0	1	1	1	5
063	M	0	1	0	1	0	1	1	1	5
064	F	0	0	0	1	1	1	1	1	5
065	F	0	0	1	0	1	1	1	1	5
066	F	0	0	0	1	1	1	1	1	5
067	M	1	0	0	0	1	1	1	1	5
068	M	0	0	0	1	1	1	1	1	5
069	M	0	0	1	1	1	1	0	1	5
071	M	0	0	0	1	1	1	1	1	5
072	F	0	0	1	1	1	1	0	1	5
073	F	0	0	1	1	0	1	1	1	5
074	M	0	0	0	1	1	1	1	1	5
075	M	0	0	0	1	1	1	1	0	4

076	M	0	0	1	1	0	0	1	1	4
077	M	0	1	1	0	0	1	1	0	4
078	M	0	0	0	0	1	1	1	1	4
079	M	0	0	0	0	1	1	1	1	4
080	M	1	1	0	0	0	0	1	1	4
081	F	0	0	0	0	1	1	1	1	4
082	M	0	0	0	1	1	1	1	0	4
083	F	0	0	0	0	1	1	1	1	4
084	F	0	0	0	1	1	0	1	1	4
085	M	0	0	1	1	0	1	0	1	4
086	F	0	0	0	1	1	1	1	0	4
087	F	0	0	1	1	0	0	0	1	3
088	F	0	0	0	1	0	1	0	1	3
089	F	0	0	0	0	0	1	1	1	3
090	F	0	0	0	0	1	1	1	0	3
091	F	0	0	0	0	1	1	1	0	3
092	F	1	0	0	0	0	1	0	1	3
093	F	0	0	0	0	0	1	1	1	3
094	F	0	1	0	0	1	0	0	1	3
095	M	0	0	0	0	1	0	1	1	3
096	F	0	0	1	0	1	0	0	0	2
097	F	0	0	0	0	1	0	1	0	2
098	F	0	0	0	0	0	0	0	1	1
099	M	0	0	0	0	0	0	1	0	1
100	F	0	0	0	0	0	0	0	0	0

TOTAL	14	34	58	75	82	86	86	87
NON-TOT	84	64	40	23	16	12	12	11
NO 1,0	0	10	10	6	8	6	7	9
NO 1,1,0	0	0	3	3	4	2	4	7
NO 1,x,0	0	0	6	5	5	4	6	7

E. Green Index of Consistency

RepB= .927

RepI= .894

Green B Index = $(\text{RepB} - \text{RepI}) / (1 - \text{RepI}) = .309$

The set of items is not Scalable

F. Reduced Guttman Score Matrix

NO		B	A	C	G	H	D	F	E	TOT	FRQ	ERR	TYP
1	*	1	1	1	1	1	1	1	1	8	0	0	8
2	*	0	1	1	1	1	1	1	1	7	21	0	7
3		1	0	1	1	1	1	1	1	7	6	1	8
4		1	1	0	1	1	1	1	1	7	2	1	8
5		1	1	1	0	1	1	1	1	7	1	1	8
6	*	0	0	1	1	1	1	1	1	6	15	0	6
7		0	1	0	1	1	1	1	1	6	3	1	7
8		0	1	1	0	1	1	1	1	6	1	1	7
9		1	0	1	1	1	0	1	1	6	1	2	8
10		1	0	0	1	1	1	1	1	6	1	1	5
11	*	0	0	0	1	1	1	1	1	5	9	0	5
12		0	1	0	1	0	1	1	1	5	3	2	7
13		0	0	1	1	1	1	0	1	5	4	1	6
14		0	0	1	1	1	1	1	0	5	1	1	6
15		0	0	1	0	1	1	1	1	5	2	1	6
16		1	0	0	0	1	1	1	1	5	1	1	4
17		0	0	1	1	0	1	1	1	5	1	1	6
18	*	0	0	0	0	1	1	1	1	4	4	0	4
19		0	0	0	1	1	1	1	0	4	3	1	5
20		0	0	1	1	0	0	1	1	4	1	2	6
21		0	1	1	0	0	1	1	0	4	1	3	7
22		1	1	0	0	0	0	1	1	4	1	2	2
23		0	0	0	1	1	0	1	1	4	1	1	5
24		0	0	1	1	0	1	0	1	4	1	2	6
25	*	0	0	0	0	0	1	1	1	3	2	0	3
26		0	0	1	1	0	0	0	1	3	1	2	1
27		0	0	0	1	0	1	0	1	3	1	2	5
28		0	0	0	0	1	1	1	0	3	2	1	4
29		1	0	0	0	0	1	0	1	3	1	2	3
30		0	1	0	0	1	0	0	1	3	1	2	1
31		0	0	0	0	1	0	1	1	3	1	1	4
32	*	0	0	0	0	0	0	1	1	2	0	0	2
33		0	0	1	0	1	0	0	0	2	1	2	1
34		0	0	0	0	1	0	1	0	2	1	2	4
35	*	0	0	0	0	0	0	0	1	1	1	0	1
36		0	0	0	0	0	0	1	0	1	1	1	2
37	*	0	0	0	0	0	0	0	0	0	1	0	1
TOTAL		14	34	58	75	82	86	86	87	158	98	60	

* -- Indicates this is an ideal scale type

G. The Guttman Coefficient of Reproducibility

Number of Errors = 60
Number of Items = 8
Number of Respondents = 98
Total Responses = 784

$$\text{Rep} = \text{Number of Errors} / \text{Total Responses} = .923$$

H. Kuder Richardson Index from Formula KR20

Sum of Item Variances = 1.221
Total Score Variance = 2.614

$$\text{KR20} = K / (K-1) [1 - (\text{SUM PQ} / \text{TOTAL VARIANCE})] = .609$$

I. Inferred Average Inter-Item Correlation

$$\text{IAC} = \text{Reliability} / [K + (1-K) (\text{Reliability})] = .163$$

SECTION III. ANALYSIS OF MULTILEVEL RESPONSES

A. Inter-Item Covariance Matrix

1.21	.08	.32	.17	.10	.26	.17	.13
.08	1.33	-.09	-.09	.04	.04	-.17	-.06
.32	-.09	1.62	.38	.41	.14	.50	.50
.17	-.09	.38	1.02	.33	.35	.43	.39
.10	.04	.41	.33	.75	.22	.40	.24
.26	.04	.14	.35	.22	.62	.31	.29
.17	-.17	.50	.43	.40	.31	1.10	.48
.13	-.06	.50	.39	.24	.29	.48	1.03

B. Pearson Product-Moment Correlation Matrix

1.00	.06	.23	.15	.11	.30	.15	.12
.06	1.00	-.06	-.08	.04	.05	-.14	-.05
.23	-.06	1.00	.29	.37	.14	.38	.38
.15	-.08	.29	1.00	.38	.44	.40	.38
.11	.04	.37	.38	1.00	.32	.44	.28
.30	.05	.14	.44	.32	1.00	.38	.37
.15	-.14	.38	.40	.44	.38	1.00	.45
.12	-.05	.38	.38	.28	.37	.45	1.00

C. Item-Total Correlation Matrix

ITEM	A	B	C	D	E	F	G	H
COVAR	2.52	1.18	3.26	3.40	2.58	2.16	3.17	3.05
r	.33	.15	.40	.55	.44	.40	.44	.47

D. Kuder-Richardson Reliability

$$K = 8$$

$$\text{Sum of Item Variances} = 8.68$$

$$\text{Total Score Variance} = 21.27$$

$$KR = K / (K - 1) [1 - (\text{SUM OF ITEM VARIANCES} / \text{TOTAL VARIANCE})] = .676$$

E. Inferred Average Correlations

$$IAC = \text{RELIABILITY} / [K + (1 - K) (\text{RELIABILITY})] = .207$$

C.3. Example 2: Data File — data2

20, 20
4
9
0, 1, 0, 1
4, 4, 3, 3
001, 0, 1, 9, 2, 8
002, 1, 7, 3, 4, 6
003, 0, 5, 5, 3, 6
004, 0, 6, 4, 4, 4
005, 1, 3, 7, 4, 6
006, 0, 14, 6, 8, 4
007, 0, 4, 5, 5, 4
008, 1, 2, 8, 4, 7
009, 1, 9, 2, 7, 1
010, 1, 9, 1, 6, 3
011, 0, 5, 4, 6, 5
012, 0, 3, 4, 5, 6
013, 0, 1, 7, 4, 8
014, 0, 1, 9, 3, 9
015, 0, 5, 7, 4, 6
016, 1, 2, 6, 3, 8
017, 1, 7, 5, 7, 5
018, 1, 0, 1, 9, 3
019, 0, 9, 1, 7, 2
020, 0, 8, 4, 8, 2

C.4. Example of Output for data2:

* * * * * INPUT INFORMATION * * * * *

CONTROL PARAMETERS:

Number of Participants = 20

Selected Participants = 20

Number of Variables = 4

Maximum Score = 9

No. of Valid Respondents = 18

No. of Invalid Respondents = 2

Items to be Reversed: B D

* * * * * ORIGINAL SCORE MATRIX * * * * *

ID	SEX	A	B	C	D	TOT
001	M	1	9	2	8	20
002	F	7	3	4	6	20
003	M	5	5	3	6	19
004	M	6	4	4	4	18
005	F	3	7	4	6	20
007	M	4	5	5	4	18
008	F	2	8	4	7	21
009	F	9	2	7	1	19
010	F	9	1	6	3	19
011	M	5	4	6	5	20
012	M	3	4	5	6	18
013	M	1	7	4	8	20
014	M	1	9	3	9	22
015	M	5	7	4	6	22
016	F	2	6	3	8	19
017	F	7	5	7	5	24
019	M	9	1	7	2	19
020	M	8	4	8	2	22

TOTAL	87	91	86	96
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* * * * * REVERSED SCORE MATRIX * * * * *

ID	SEX	A	B	C	D	TOT
001	M	1	1	2	2	6
002	F	7	7	4	4	22

003	M	5	5	3	4	17
004	M	6	6	4	6	22
005	F	3	3	4	4	14
007	M	4	5	5	6	20
008	F	2	2	4	3	11
009	F	9	8	7	9	33
010	F	9	9	6	7	31
011	M	5	6	6	5	22
012	M	3	6	5	4	18
013	M	1	3	4	2	10
014	M	1	1	3	1	6
015	M	5	3	4	4	16
016	F	2	4	3	2	11
017	F	7	5	7	5	24
019	M	9	9	7	8	33
020	M	8	6	8	8	30

TOTAL 87 89 86 84

* * * * * RESULTS OF DATA ANALYSIS * * * * *

SECTION I. SUMMARY STATISTICS

A. Frequencies for Each Item

ANSWER	A	B	C	D
1	3	2	0	1
2	2	1	1	3
3	2	3	3	1
4	1	1	6	5
5	3	3	2	2
6	1	4	2	2
7	2	1	3	1
8	1	1	1	2
9	3	2	0	1
TOTAL	18	18	18	18

B. Percentages for Each Item

ANSWER	A	B	C	D
1	.17	.11	.00	.06
2	.11	.06	.06	.17
3	.11	.17	.17	.06
4	.06	.06	.33	.28
5	.17	.17	.11	.11
6	.06	.22	.11	.11
7	.11	.06	.17	.06
8	.06	.06	.06	.11
9	.17	.11	.00	.06

ITEM	MEAN	STD	VARIANCE
A	4.83	2.87	8.26
B	4.94	2.46	6.06
C	4.78	1.70	2.89
D	4.67	2.30	5.29
TOTAL	19.22	8.73	76.18

SECTION II. ANALYSIS OF DICHOTOMIZED RESPONSES

A. The Dichotomized Score Matrix

ID	SEX	A	B	C	D	TOT
001	M	0	0	0	0	0
002	F	1	1	1	1	4
003	M	1	1	0	1	3
004	M	1	1	1	1	4
005	F	0	0	1	1	2
007	M	0	1	1	1	3
008	F	0	0	1	0	1
009	F	1	1	1	1	4
010	F	1	1	1	1	4
011	M	1	1	1	1	4
012	M	0	1	1	1	3

013	M	0	0	1	0	1
014	M	0	0	0	0	0
015	M	1	0	1	1	3
016	F	0	0	0	0	0
017	F	1	1	1	1	4
019	M	1	1	1	1	4
020	M	1	1	1	1	4

TOTAL 10 11 14 13
 Dichotomization
 Point 4 4 3 3

• • B. Frequencies for Dichotomized Score

ANSWER	A	B	C	D
0	8	7	4	5
1	10	11	14	13

C. Percentages for Dichotomized Score

ANSWER	A	B	C	D
0	.44	.39	.22	.28
1	.56	.61	.78	.72

D. The Guttman Scale Score Matrix

ID	SEX	A	B	D	C	TOT
001	M	1	1	1	1	4
002	F	1	1	1	1	4
003	M	1	1	1	1	4
004	M	1	1	1	1	4
005	F	1	1	1	1	4
007	M	1	1	1	1	4
008	F	1	1	1	1	4
009	F	1	1	1	1	4
010	F	1	0	1	1	3
011	M	0	1	1	1	3

012	M	0	1	1	1	3
013	M	1	1	1	0	3
014	M	0	0	1	1	2
015	M	0	0	0	1	1
016	F	0	0	0	1	1
017	F	0	0	0	0	0
019	M	0	0	0	0	0
020	M	0	0	0	0	0

TOTAL	10	11	13	14
NON-TOT	8	7	5	4
NO 1,0	0	1	0	1
NO 1,1,0	0	0	0	1
NO 1,x,0	0	0	0	1

E. Green Index of Consistency

RepB= .972 RepI= .858
Green B Index = (RepB-RepI)/(1-RepI)= .804

F. Reduced Guttman Score Matrix

NO		A	B	D	C	TOT	FRQ	ERR	TYP
1	*	1	1	1	1	4	8	0	4
2	*	0	1	1	1	3	2	0	3
3		1	0	1	1	3	1	1	4
4		1	1	1	0	3	1	1	4
5	*	0	0	1	1	2	1	0	2
6	*	0	0	0	1	1	2	0	1
7	*	0	0	0	0	0	3	0	1
TOTAL		10	11	13	14	16	18	2	

* -- Indicates this is an ideal scale type

G. The Guttman Coefficient of Reproducibility

Number of Errors = 2
Number of Items = 4

Number of Respondents = 18

Total Responses = 72

Rep = Number of Errors / (Total Responses) = .972

H. Kuder Richardson Index from Formula KR20

Sum of Item Variances = .858

Total Score Variance = 2.471

KR20 = $K / (K - 1) [1 - (\text{SUM PQ} / \text{TOTAL VARIANCE})]$ = .870

I. Inferred Average Inter-Item Correlation

IAC = Reliability / $[K + (1 - K) (\text{Reliability})]$ = .626

SECTION III. ANALYSIS OF MULTILEVEL RESPONSES

A. Inter-Item Covariance Matrix

8.26	6.23	3.78	5.94
6.23	6.06	2.93	4.69
3.78	2.93	2.89	3.27
5.94	4.69	3.27	5.29

B. Pearson Product-Moment Correlation Matrix

1.00	.88	.77	.90
.88	1.00	.70	.83
.77	.70	1.00	.84
.90	.83	.84	1.00

C. Item-Total Correlation Matrix

ITEM	A	B	C	D
COVAR	24.16	20.41	14.42	20.06

r .95 .87 .92 .93

D. Kuder-Richardson Reliability

K = 4

Sum of Item Variances = 22.50

Total Score Variance = 76.18

$KR = K / (K - 1) [1 - (\text{SUM OF ITEM VARIANCES} / \text{TOTAL VARIANCE})] = .939$

E. Inferred Average Correlations

$IAC = \text{RELIABILITY} / [K + (1 - K) (\text{RELIABILITY})] = .795$

APPENDIX D — Program Listing

C Filename: atmeas.f; Create date: Oct. 3, 1992; Revise date: Dec. 6, 1993

C

C This Program is for Analyzing Data of Attitude Measurement

C

PROGRAM FINAL

C

C (1) Create Space for All the Arrays

C

PARAMETER (N=500, K=26, NANSR=9)

INTEGER SEX(N), SCORE(N,K), SC(K), DISTR(K), ACCUVAR, HALFSUM,
1FREQNCY(NANSR, K), REVERSE(K), SCORIGIN(N, K), SUMFREQ(K),
2NDICH0(K), NDICH1(K), BORDER01(K), SCDICH(N, K), TOTRORG(N),
3TOTCORG(K), TOTRROD(N), TOTCROD(K), TOTR01(N), TOTC01(K),
4SCGUTM(N,K), TOTRGUTM(N), TOTCGUTM(K), TOTR01T(N), TOTC01T(K),
5SCGUTMT(N,K), SCGUTMR(N,K), NREPEAT(N), TRGUTMR(N), NERROR(N),
6NTYPE(N), TOTERR, SCGUTMF(N,K), FREQF(N), NTYPEF(N), NERRORF(N),
7TRGUTMF(N), TOTONE, NLESTOT(K), NGRN10(K), NGRN110(K),
8NGRN1X0(K), FREQSUM(N), FRESUM2(N), SUMVAR(K), NUNVLD(N),
9SCORETT(N,K), MARK(N)

REAL KR20D, KR20M, INFAVED, INFAVEM

DIMENSION SCMEAN(K), SCVAR(K), SCSTD(K), PERCENT(NANSR, K),
1PRCNT(NANSR), PRCNT0(K), PRCNT1(K), RELI(K,K), PEARSN(K,K),
2COVSCTT(K), STDSCTT(K)

CHARACTER*1 SEXCH(N), VARNAME(K), VNREODR(K), STAR(N)

CHARACTER*3 TOT, ERROR, NFREQ, TYPE, IDNUM(N), IDTEMP

CHARACTER*10 FileName

TOT='TOT'

ERROR='ERR'

NFREQ='FRQ'

TYPE='TYP'

C

C (2) Read Control Parameters

C

Write (*,*) 'Please Enter Data File Name: '

Read (*, 1111) FileName

1111 Format (A10)

OPEN (12, FILE=FileName)

READ (12, 1000) NPEOPLE, NSELECTI

```

      READ (12, 1025) NVAR
      READ (12, 1050) MAXSC
      NSELECT=NSELECTI
      NANSWER=MAXSC
1000 FORMAT (2I4)
1025 FORMAT (I3)
1050 FORMAT (I2)
C
C (3) Form the Character Array VARNAME(K) for the Names of Variables
C
      DATA VARNAME/'A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I',
1'J', 'K', 'L', 'M', 'N', 'O', 'P', 'Q', 'R', 'S', 'T', 'U',
2'V', 'W', 'X', 'Y', 'Z'/
C
C (4) Read Data from Data File and Pre-Processing
C
C Set Counters for Numbers of Female, Male and People Who Have Valid Data
      NFEM=0
      NMAL=0
      NVALID=0
C Read Array REVERSE(K) Which Indicates the Direction of Attitude
C   REVERSE(I)=0 --- from Disagree to Agree
C   REVERSE(I)=1 --- from Agree to Disagree
      READ (12,*) (REVERSE(I), I=1, NVAR)
C
C Read Data Indicating the Border for Dichotomizing Analysis
C
      READ (12,*) (BORDER01(I),I=1,NVAR)
C Delete Invalid Data When Any Score is Greater Than MAXSC or Equal to Zero
      DO 1 I=1,NPEOPLE
          NUNVLD(I)=0
1  CONTINUE
C
C Read Data from the Input Data File
C
      DO 10 I=1, NPEOPLE
          READ (12,2222) IDTEMP, NSEX, (SC(L), L=1,NVAR)
2222 FORMAT (A3,1X,I2,1X,26(I2,1X))
          DO 5 J=1, NVAR
              IF (SC(J).GT.MAXSC) THEN
                  NUNVLD(I)=1
                  GO TO 10
              ELSE

```

```

    END IF
    IF (SC(J).EQ.0) THEN
        NUNVLD(I)=1
        GO TO 10
    ELSE
        END IF
5 CONTINUE
C Put Valid Data into Their Arrays, SEX(I), AND SCORE(I,J)
    NVALID=NVALID+1
    IDNUM(NVALID)=IDTEMP
    SEX(NVALID)=NSEX
    DO 15 M=1, NVAR
15 SCORE(NVALID,M)=SC(M)
C Get the Accumulated Numbers of Males and Females
    IF (NSEX.EQ.1) THEN
        NFEM=NFEM+1
    ELSE
        NMAL=NMAL+1
    END IF
    IF (NVALID.EQ.NSELECT) GO TO 20
    NINVALID=NPEOPLE-NVALID
10 CONTINUE
20 CONTINUE
    IF (NSELECT.GT.NVALID) NSELECT=NVALID
C Reverse the Sequence of Answers for the Variables Which Have REVERSE(I)=1
C SCORIGIN(I,J) has the origin scores, SCORE(I,J) has the reordered scores.
    DO 21 I=1, NSELECT
    DO 22 J=1, NVAR
        SCORIGIN(I,J)=SCORE(I,J)
22 CONTINUE
21 CONTINUE
    DO 25 I=1, NVAR
        IF (REVERSE(I).EQ.0) GO TO 25
        CALL REORDER (N, K, NSELECT, SCORE, I, MAXSC)
25 CONTINUE
C
C (5) Calculate Mean, Variance and STD for Each Scale Item
    DO 30 J=1, NVAR
        CALL MEAN(N, K, NSELECT, NVAR, SCORE, J, SMEAN, VAR, STD)
        SCMEAN(J)=SMEAN
        SCVAR(J)=VAR
        SCSTD(J)=STD
30 CONTINUE

```

```

C
C (6) Calculate Frequency and Percentage for Each Scale Item
  DO 40 II=1, NVAR
    CALL FREQ(N,K,NSELECT,NVAR,NANSWER,II,SCORE,DISTR,PRCNT)
    DO 50 J=1, NANSWER
      FREQNCY (J, II)=DISTR(J)
    50 PERCENT (J, II)=PRCNT(J)
  40 CONTINUE
C   SUM OF EACH ITEM SUMVAR(K)
  DO 55 I=1,NVAR
    SUMVAR(I)=0
  55 CONTINUE
  DO 56 I=1,NVAR
    DO 57 J=1,NANSWER
      SUMVAR(I)=SUMVAR(I)+FREQNCY(J,I)
    57 CONTINUE
  56 CONTINUE
C
C (7) Transform the Raw Scores into 0-1 Scale from the
C   Dichotomized Frequency Array NDICH0(NVAR) and NDICH1(NVAR)
C
C   DO 60 I=1, NVAR
C   ACCUVAR=0
C   DO 70 J=1,NANSWER
C   ACCUVAR=ACCUVAR+FREQNCY(J, I)
C   HALFSUM=NSELECT/2
C   IF (ACCUVAR.GT.HALFSUM) THEN
C     NDICH0(I)=ACCUVAR-FREQNCY(J, I)
C     NDICH1(I)=NSELECT-NDICH0(I)
C     BORDER01(I)=J-1
C     GO TO 60
C   ELSE
C     GO TO 70
C   END IF
C 70 CONTINUE
C 60 CONTINUE
C
C (8) Form the Dichotomized Score Matrix SCDICH(N,K)
C   (Convert Original Score Matrix into 0-1 Scale)
C
  DO 90 I=1, NVAR
    DO 90 J=1, NSELECT
      IF (SCORE(J,I).LE.BORDER01(I)) THEN

```

```

        SCDICH(J,I)=0
    ELSE
        SCDICH(J,I)=1
    END IF
90 CONTINUE
C  FIND THE PERCENTAGE OF 0 AND 1, PRCNT0(NVAR) AND PRCNT1(NVAR)
    DO 80 I=1,NVAR
        NUM0=0
        DO 75 J=1,NSELECT
            IF (SCDICH(J,I).EQ.0) THEN
                NUM0=NUM0+1
            ELSE
            END IF
75    CONTINUE
        NDICH0(I)=NUM0
        NDICH1(I)=NSELECT-NDICH0(I)
        PRCNT0(I)=REAL(NDICH0(I))/REAL(NSELECT)
        PRCNT1(I)=REAL(NDICH1(I))/REAL(NSELECT)
80    CONTINUE
C
C  (9) Calculate the Totals of Each Row and Column of the Score Matrices
C  For the Original Score Matrix SCORIGIN(N,K)
    CALL TOTAL(N, K, NSELECT, NVAR, SCORIGIN, TOTRORG, TOTCORG)
    CALL TOTAL(N, K, NSELECT, NVAR, SCORE, TOTRROD, TOTCROD)
    CALL TOTAL(N, K, NSELECT, NVAR, SCDICH, TOTR01, TOTC01)
C  Calculate the mean, variance, and STD of row totals of the reordered
    CALL MEAN(N,1,NSELECT,1,TOTRROD,1,TOTMEAN,TOTVAR,TOTSTD)
C
C  (10) Form the Guttman Score Matrix SCGUTM(N,K) by Reordering the
C      Dichotomized 0-1 Matrix SCDICH(N, K) through Putting the
C      Total Scores in Sequence
C
C  Store TOTR01(N), and TOTC01(K) into Temporary Arrays
    DO 95 I=1, N
        TOTR01T(I)=TOTR01(I)
95    CONTINUE
    DO 100 I=1, K
        TOTC01T(I)=TOTC01(I)
100    CONTINUE
C  Go by Column, Find the Minimum Total Score of Column, TOTCMIN
    DO 105 I=1, NVAR
        TOTCMIN=9999
        DO 110 J=1, NVAR

```

```

      IF (TOTC01T(J).LT.TOTCMIN) THEN
        TOTCMIN=TOTC01T(J)
        NCMIN=J
      ELSE
        END IF
110  CONTINUE
      TOTC01T(NCMIN)=99999
      TOTCGUTM(I)=TOTC01(NCMIN)
      DO 115 II=1, NSELECT
115  SCGUTMT(II,I)=SCDICH(II,NCMIN)
      VNREODR(I)=VARNAME(NCMIN)
105  CONTINUE
C   Go by Row, Find the Minumum Total Score of Row First, MINROW
      DO 120 I=1, NSELECT
        TOTRMAX=0
        DO 125 J=1, NSELECT
          IF (TOTR01T(J).GE.TOTRMAX) THEN
            TOTRMAX=TOTR01T(J)
            NRMAX=J
          ELSE
            END IF
125  CONTINUE
        TOTR01T(NRMAX)=-1
        TOTRGUTM(I)=TOTR01(NRMAX)
        DO 130 II=1, NVAR
130  SCGUTM(I,II)=SCGUTMT(NRMAX,II)
120  CONTINUE
C
C   (11) Calculate the Green Index of Consistency from the
C       Guttman Score Matrix SCGUTM(N,K) and TOTCGUTM(K)
C
C   Form the Arrays that Derived from SCGUTM(N,K) and TOTCGUTM(K)
      DO 1100 I=1, NVAR
        NLESTOT(I)=NSELECT-TOTCGUTM(I)
1100 CONTINUE
        NGRN10(1)=0
        DO 1150 I=2,NVAR
          NGRN10(I)=0
          DO 1175 J=1, NSELECT
            IF (SCGUTM(J,I).EQ.0) THEN
              INDEX=I-1
              IF (SCGUTM(J,INDEX).EQ.1) THEN
                NGRN10(I)=NGRN10(I)+1

```

```

        ELSE
        END IF
    ELSE
    END IF
1175 CONTINUE
1150 CONTINUE
    NGRN110(1)=0
    NGRN110(2)=0
    DO 1200 I=3, NVAR
    NGRN110(I)=0
    DO 1225 J=1, NSELECT
    IF (SCGUTM(J,I).EQ.0) THEN
        IND=I-1
        IF (SCGUTM(J,IND).EQ.1) THEN
            INDEX=I-2
            IF (SCGUTM(J,INDEX).EQ.1) THEN
                NGRN110(I)=NGRN110(I)+1
            ELSE
            END IF
        ELSE
        END IF
    ELSE
    END IF
    ELSE
    END IF
1225 CONTINUE
1200 CONTINUE
    NGRN1X0(1)=0
    NGRN1X0(2)=0
    DO 1250 I=3,NVAR
    NGRN1X0(I)=0
    DO 1275 J=1,NSELECT
    IF (SCGUTM(J,I).EQ.0) THEN
        INDEX=I-2
        IF (SCGUTM(J,INDEX).EQ.1) THEN
            NGRN1X0(I)=NGRN1X0(I)+1
        ELSE
        END IF
    ELSE
    END IF
1275 CONTINUE
1250 CONTINUE
    NSUMG10=0
    NSUM110=0
    DO 1300 I=1,NVAR

```



```

      NSUMG10=NSUMG10+NGRN10(I)
      NSUM110=NSUM110+NGRN110(I)
1300 CONTINUE
      NSUMDIA=0
      DO 1325 I=1, (NVAR-1)
        NSUMDIA=NSUMDIA+TOTCGUTM(I)*NLESTOT(I+1)
1325 CONTINUE
      NSUMZIG=0
      DO 1350 I=1, (NVAR-3)
        NSUMZIG=NSUMZIG+TOTCGUTM(I)*TOTCGUTM(I+1)*NLESTOT(I+2)
        1*NLESTOT(I+3)
1350 CONTINUE
      NEXT1X0=0
      DO 1375 I=3, (NVAR-1)
        NEXT1X0=NEXT1X0+NGRN1X0(I)*NGRN1X0(I+1)
1375 CONTINUE
C      REPA=1.0-REAL(NSUMG10)/REAL(NSELECT*NVAR)-
C      1REAL(NSUM110)/REAL(NSELECT*NVAR)
      REPB=1.0-REAL(NSUMG10)/REAL(NSELECT*NVAR)-
      1REAL(NEXT1X0)/REAL(NSELECT**2*NVAR)
      REPI=1.0-REAL(NSUMDIA)/REAL(NSELECT**2*NVAR)-
      1REAL(NSUMZIG)/REAL(NSELECT**4*NVAR)
      GREEN=(REPB-REPI)/(1-REPI)
C
C (12) Reduce the Guttman Matrix into One Having One kind for Each Line
C      -- from SCGUTM(N,K) into SCGUTMR(N,K)
C
C Set Counter for the Final Number of Lines OF SCGUTMR(N,K),
C and the Size of NREPEAT(N), NLINE
      NLINE=0
      NSAME=1
      DO 131 I=1, N
        MARK(I)=0
        NREPEAT(I)=1
131 CONTINUE
      DO 133 IJK=1, NSELECT
        IF (MARK(IJK).EQ.1) GO TO 133
        NLINE=NLINE+1
        DO 134 IJJ=1,NVAR
          SCGUTMR(NLINE,IJJ)=SCGUTM(IJK,IJJ)
134 CONTINUE
        TRGUTMR(NLINE)=TOTRGUTM(IJK)
        MARK(IJK)=1

```

```

DO 135 I=1, NSELECT
  IF (MARK(I).EQ.1) GO TO 135
  DO 140 J=1, NVAR
    IF (SCGUTM(I, J).EQ.SCGUTMR(NLINE, J)) THEN
      GO TO 140
    ELSE
      NSAME=1
      GO TO 135
    END IF
  140 CONTINUE
  NREPEAT(NLINE)=NREPEAT(NLINE)+1
  MARK(I)=1
135 CONTINUE
133 CONTINUE
C
C (13) Find Errors for Each Type of Response
C
  DO 145 I=1, NLINE
    NERROR(I)=9999
C Compare each line of SCGUTMR(I,J) with each line of a top diagonal
C unit matrix, the number of differences is the number of error, NERR
    DO 150 JJ=1, NVAR
      NERR=0
      DO 155 J=1, NVAR
        IF (J.GE.JJ) THEN
          IF (SCGUTMR(I, J).EQ.0) THEN
            NERR=NERR+1
          ELSE
            END IF
        ELSE
          IF (SCGUTMR(I, J).EQ.1) THEN
            NERR=NERR+1
          ELSE
            END IF
          END IF
        155 CONTINUE
        IF (NERR.LT.NERROR(I)) THEN
          NERROR(I)=NERR
          NTYPE(I)=NVAR+1-JJ
        ELSE
          END IF
      150 CONTINUE
C Compare to the special case which is all zero of a line

```

```

      NERR=0
      DO 160 II=1, NVAR
        IF (SCGUTMR(I, II).EQ.1) THEN
          NERR=NERR+1
        ELSE
          END IF
160    CONTINUE
      IF (NERR.LT.NERROR(I)) NERROR(I)=NERR
145 CONTINUE
C
C (14) Calculate the Guttman Reproducibility Index
C
C Get the Total Error TOTERR
      TOTERR=0
      DO 165 I=1, NLINE
        TOTERR=TOTERR+NERROR(I)*NREPEAT(I)
165 CONTINUE
C The Reproducibility Index, REPRO
      REPRO=REAL(TOTERR)/(REAL(NSELECT)*REAL(NVAR))
      REPRO=1-REPRO
C
C (15) Add Ideal Types into the Guttman Score Matrix and Form
C the Final Score Matrix SCGUTMF(N,K)
C
      DO 166 I=1, N
        STAR(I)='*'
        FREQF(I)=0
        NERRORF(I)=0
166 CONTINUE
C Set Counter for the Number of Lines of SCGUTMF(N,K), NF
      NF=1
      DO 168 IJ=1, NVAR
        TOTONE=NVAR+1-IJ
C Form the Ideal Type Line Which Has TOTONE 1's
      DO 169 IJK=1, NVAR
        IF (IJK.GE.IJ) THEN
          SCGUTMF(NF, IJK)=1
        ELSE
          SCGUTMF(NF, IJK)=0
        END IF
169 CONTINUE
      NTYPEF(NF)=TOTONE
      TRGUTMF(NF)=TOTONE

```

```

      NF=NF+1
      NSAMETOT=0
DO 170 I=1, NLINE
  IF (TRGUTMR(I).NE.TOTONE) GO TO 170
  NSAMETOT=NSAMETOT+1
  DO 175 J=1, TOTONE
    JJ=NVAR+1-J
    IF (SCGUTMR(I, JJ).EQ.1) THEN
      GO TO 175
    ELSE
      DO 185 KK=1, NVAR
        SCGUTMF(NF, KK)=SCGUTMR(I, KK)
185    CONTINUE
        STAR(NF)= ' '
        FREQF(NF)=NREPEAT(I)
        NERRORF(NF)=NERROR(I)
        NTYPEF(NF)=NTYPE(I)
        TRGUTMF(NF)=TRGUTMR(I)
        NF=NF+1
        GO TO 170
      END IF
175    CONTINUE
        NF=NF-NSAMETOT
        FREQF(NF)=NREPEAT(I)
        NERRORF(NF)=NERROR(I)
        NTYPEF(NF)=NTYPE(I)
        TRGUTMF(NF)=TRGUTMR(I)
        NF=NF+NSAMETOT
170  CONTINUE
168  CONTINUE
C  Check the Last Line of SCGUTMR(N,K), To See Weather It Is All Zero
      DO 180 I=1, NVAR
        IF (SCGUTMR(NLINE, I).NE.0) GO TO 190
180  CONTINUE
        FREQF(NF)=NREPEAT(NLINE)
        NERRORF(NF)=NERROR(NLINE)
        NTYPEF(NF)=NTYPE(NLINE)
        TRGUTMF(NF)=TRGUTMR(NLINE)
190  CONTINUE
C  CALCULATE THE TOTAL OF TRGUTMF(NF), FREQF(NF) AND NERRORF(NF)
      NSUMTRG=0
      NSUMFRQ=0
      NSUMERR=0

```

```

DO 157 I=1,NF
  NSUMTRG=NSUMTRG+TRGUTMF(I)
  NSUMFRQ=NSUMFRQ+FREQF(I)
  NSUMERR=NSUMERR+NERRORF(I)*FREQF(I)
157 CONTINUE

C
C (16) CALCULATE KR20D USING KUDDER RICHARDSON FORMULA 20
C
  SUMPQ=0.0
  DO 300 I=1,NVAR
    SUMPQ=SUMPQ+PRCNT0(I)*PRCNT1(I)
300 CONTINUE
C  FOR TOTAL VARIANCE OF DICHOTAMIZED -- TOTVARD
C  DO 310 I=1,NF
C    FREQSUM(I)=TRGUTMF(I)*FREQF(I)
C    FRESUM2(I)=TRGUTMF(I)**2*FREQF(I)
C 310 CONTINUE
C  SUMX2F=0
C  DO 320 I=1,NF
C    SUMX2F=SUMX2F+FRESUM2(I)
C 320 CONTINUE
C  SUMXFRE=0
C  DO 330 I=1,NF
C    SUMXFRE=SUMXFRE+FREQSUM(I)
C 330 CONTINUE
C  TOTVARD=(SUMX2F-SUMXFRE**2/NSELECT)/NSELECT
C  CALL MEAN(N,1,NSELECT,1,TOTR01,1,MEANT01,TOTVARD,STDT01)
C  KR20D=(1-SUMPQ/TOTVARD)*NVAR/(NVAR-1)
C  CALCULATE INFERRED AVERAGE CORRELATION
C  INFAVED=KR20D/(NVAR+(1-NVAR)*KR20D)
C
C (17) CALCULATE KR20M USING KUDDER RICHARDSON FORMULA 20
C
  SUMVITM=0
  DO 340 I=1,NVAR
    SUMVITM=SUMVITM+SCVAR(I)
340 CONTINUE
  KR20M=(1-SUMVITM/TOTVAR)*NVAR/(NVAR-1)
C  CALCULATE INFERRED AVERAGE CORRELATION
C  INFAVEM=KR20M/(NVAR+(1-NVAR)*KR20M)
C
C (18) CALCULATE THE RELIABILITY MATRIX FROM RE-ORDERED SCORE MATRIX

```

```

C
C FORM THE RELIABILITY MATRIX
  DO 370 I=1,NVAR
  DO 370 J=I,NVAR
  CALL RELIAB(N,K,NSELECT,NVAR,SCORE,I,J,COVIJ,RIJ)
  RELI(I,J)=COVIJ
  PEARSN(I,J)=RIJ
370 CONTINUE
C FILL THE UPPER TRIANGLE OF THE MATRICES
  DO 380 I=1,NVAR
  DO 380 J=1,I
  RELI(I,J)=RELI(J,I)
  PEARSN(I,J)=PEARSN(J,I)
380 CONTINUE
C
C (19) CALCULATE THE CORARIANCES BETWEEN EACH ITEM AND THE
C   TOTAL SCORE LESS THE SCORE OF THE ITEM
C   --- SCORE(NSELECT,NVAR) AND TOTRROD(NSELECT)
C
C FILL A NEW MATRIX AS SCORE(NSELECT,NVAR) PLUS TOTRROD(NSELECT)
  DO 390 I=1,NSELECT
  DO 390 J=1,NVAR
  SCORETT(I,J)=SCORE(I,J)
390 CONTINUE
  NSCTT=NVAR+1
400 CONTINUE
  DO 410 I=1,NVAR
  DO 420 J=1,NSELECT
  SCORETT(J,NSCTT)=TOTRROD(J)-SCORE(I,J)
420 CONTINUE
  CALL RELIAB(N,K,NSELECT,NVAR,SCORETT,I,NSCTT,COVST,STDST)
  COVSCTT(I)=COVST
  STDSCTT(I)=STDST
410 CONTINUE
C
C * * * * *
C * Output -- Data and Results *
C * * * * *
C
  OPEN (13, FILE='results')
C Represent the SES(N) by the Letters "F" and "M"
  DO 525 I=1, NSELECT
  IF (SEX(I). EQ. 0) THEN

```

```

        SEXCH(I)='M'
    ELSE
        SEXCH(I)='F'
    END IF
525  CONTINUE
C
C (1) Print out the input information
C
    WRITE (13, 2050)
2050 FORMAT (///, 20X, '***** INPUT INFORMATION *****', ///)
    WRITE (13, 2100) NPEOPLE, NSELECTI, NVAR, MAXSC,
    1INVALID, NSELECTI-NVALID
2100 FORMAT (/, 10X, 'CONTROL PARAMETERS:', //, 10X,
    1'Number of Participants =', I4, /, 10X,
    1'Selected Participants =', I4, //, 10X,
    1'Number of Variables =', I3, /, 10X,
    1'Maximum Score =', I2, //, 10X,
    1'No. of Valid Responds is:', I3, /, 10X,
    1'No. of Invalid Responds is:', I3)
    WRITE (13, 2130)
2130 FORMAT (////, 10X, '***** ORIGINAL SCORE MATRIX *****', /)
    WRITE (13, 2150) (VARNAME(I), I=1, NVAR), TOT
2150 FORMAT (/, 1X, 'ID ', 1X, 'SEX', 26A4)
    DO 500 I=1, NSELECT
    WRITE (13, 2160)
    WRITE (13, 2200) IDNUM(I), SEXCH(I), (SCORIGIN(I,J), J=1, NVAR),
    1TOTRORG(I)
2160 FORMAT(1X, ' ')
2200 FORMAT (A3, 3X, A1, 1X, 26I4)
    500 CONTINUE
    WRITE (13, 2160)
    WRITE (13, 2170) (TOTCORG(I), I=1, NVAR)
2170 FORMAT(3X, 'TOTAL', 26I4)
C
C (2) Print out the Re-Ordered Score Matrix
C
    WRITE (13, 2210)
2210 FORMAT (///, 10X, '***** RE-ORDERED SCORE MATRIX *****', /)
    WRITE (13, 2150) (VARNAME(I), I=1, NVAR), TOT
    DO 550 I=1, NSELECT
    WRITE (13, 2160)
    WRITE (13, 2200) IDNUM(I), SEXCH(I), (SCORE(I,J), J=1, NVAR),
    1TOTRRORD(I)

```

```

550 CONTINUE
    WRITE (13, 2160)
    WRITE (13, 2170) (TOTCROD(I), I=1, NVAR)
    WRITE (13,2250)
2250 FORMAT(////,15X,'* * * * * RESULTS OF DATA ANALYSIS * * * * *'
1,/)
    WRITE (13, 2275)
2275 FORMAT(/,'SECTION I. SUMMARY STATISTICS',/)
C
C (4) Print out Frequency and Percentage of Each Scale Variable
C
    WRITE (13, 2700)
2700 FORMAT ('A. Frequencies for Each Item',/)
    WRITE (13, 2750) (VARNAME(I), I=1, NVAR)
2750 FORMAT ('ANSWER', 26A4, //)
    DO 600 I=1, NANSWER
    600 WRITE (13, 2800) I, (FREQNCY(I, J), J=1, NVAR)
2800 FORMAT (/, I4, 2X, 26I4)
    WRITE (13,2850) (SUMVAR(I), I=1,NVAR)
2850 FORMAT (/,'TOTAL ',26I4)
    WRITE (13, 2900)
2900 FORMAT (//,'B. Percentages for Each Item',/)
    WRITE (13, 2751) (VARNAME(I), I=1, NVAR)
2751 FORMAT ('ANSWER', 26A5, //)
    DO 700 I=1, NANSWER
    700 WRITE (13, 3000) I, (PERCENT(I, J), J=1, NVAR)
3000 FORMAT (/, I4, 2X, 26F5.2)
C
C (3) Print Out the Mean, Variance and STD of Each Scale Item
C
    WRITE (13,2276)
2276 FORMAT (//'ITEM ', 5X,'MEAN', 8X, 'STD', 5X, 'VARIANCE',/)
    DO 2350 I=1, NVAR
    WRITE (13, 2400) VARNAME(I), SCMEAN(I), SCSTD(I), SCVAR(I)
2400 FORMAT (2X, A2, 3(5X, F6.2))
2350 CONTINUE
    WRITE (13, 2500) TOTMEAN, TOTSTD, TOTVAR
2500 FORMAT (/,1X, 'TOTAL', 3X, F6.2, 2(5X,F6.2))

C
C Dichotomized Data Analysis
C
    WRITE (13, 3050)

```


3050 FORMAT (///, 'SECTION II. ANALYSIS OF DICHOTOMIZED RESPONSES')

C

C (5) Print Out the Dichotomized Score Matrix

C

WRITE (13, 3250)

3250 FORMAT(/, 'A. The Dichotomized Score Matrix')

WRITE (13, 2150) (VARNAME(I), I=1, NVAR), TOT

DO 800 I=1, NSELECT

WRITE (13, 2160)

800 WRITE (13, 2200) IDNUM(I),SEXCH(I),(SCDICH(I,J),J=1, NVAR),
1TOTR01(I)

WRITE (13, 2160)

WRITE (13, 2170) (TOTC01(I), I=1, NVAR)

WRITE (13, 3205)

3205 FORMAT ('Dichotomous')

WRITE (13, 3210) (BORDER01(I), I=1, NVAR)

3210 FORMAT ('Point', 3X, 26I4)

C

C (6) Print out the Frequency and Percentage of Dichotomized Score

C

WRITE (13, 3100)

3100 FORMAT(//, 'B. Frequencies for Dichotomized Score', /)

WRITE (13, 2750) (VARNAME(I), I=1, NVAR)

N0=0

N1=1

WRITE (13, 2800) N0, (NDICH0(I), I=1, NVAR)

WRITE (13, 2800) N1, (NDICH1(I), I=1, NVAR)

WRITE (13, 3200)

3200 FORMAT(//, 'C. Percentages for Dichotomized Score', /)

WRITE (13, 2751) (VARNAME(I), I=1, NVAR)

N0=0

N1=1

WRITE (13, 3000) N0, (PRCNT0(I), I=1, NVAR)

WRITE (13, 3000) N1, (PRCNT1(I), I=1, NVAR)

C

C (7) Print out the Specially Formed Guttman Score Matrix, SCGUTM(N,K)

C

WRITE (13, 3300)

3300 FORMAT(//, 'D. The Guttman Scale Score Matrix')

WRITE (13, 2150) (VNREODR(I), I=1, NVAR), TOT

DO 900 I=1, NSELECT

WRITE (13, 2160)

900 WRITE (13, 2200) IDNUM(I),SEXCH(I),(SCGUTM(I,J),J=1, NVAR),

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1TOTRGUTM(I)
WRITE (13, 2160)
WRITE (13, 2170) (TOTCGUTM(I), I=1, NVAR)
WRITE (13, 3481) (NLESTOT(I), I=1, NVAR)
WRITE (13, 3482) (NGRN10(I), I=1, NVAR)
WRITE (13, 3483) (NGRN110(I), I=1, NVAR)
WRITE (13, 3484) (NGRN1X0(I), I=1, NVAR)
3481 FORMAT (3X, 'N-TOT', 26I4)
3482 FORMAT (3X, 'N 10', 26I4)
3483 FORMAT (3X, 'N 110', 26I4)
3484 FORMAT (3X, 'N 1x0', 26I4)
C
C (8) Print out the Green Index of Consistency
C
      WRITE (13,3650)
3650 FORMAT (/, 'E. Green Index of Consistency',/)
C      WRITE (13, 3651) NSUMDIA, NSUMZIG
C 3651 FORMAT (5X, 'NSUMDIA=', I5, 20X, 'NSUMZIG=', I5, /)
      WRITE (13, 3675) REPB, REPI
3675 FORMAT (5X, 'RepB=', F6.3, 10X, 'RepI=', F6.3)
      WRITE (13, 3700) GREEN
3700 FORMAT (5X, 'Green B Index of Consistency = (RepB-RepI)/(1-RepI)=' ,
1F6.3,/)
      IF (GREEN .LT. 0.5) THEN
        WRITE (13, 3705)
3705 FORMAT (5X, 'The set of items is not Scalable',/)
      END IF
C
C (9) Print out the Reduced Guttman Score Matrix, SCGUTMR(NLINE,NVAR)
C with Frequency-of-Occurrence and Error
C
      WRITE (13, 3400)
3400 FORMAT(/, 'F. Reduced Guttman Score Matrix')
      WRITE (13, 3450) (VNREODR(I),I=1, NVAR), TOT,NFREQ,ERROR,TYPE
3450 FORMAT(/, 1X, 'NO', 3X, 26A4)
      DO 950 I=1, NF
        WRITE (13, 2160)
        WRITE (13, 3475) I,STAR(I),(SCGUTMF(I,J),J=1, NVAR),TRGUTMF(I),
1FREQF(I), NERRORF(I), NTYPEF(I)
3475 FORMAT (I3, 2X, A1, 26I4)
950 CONTINUE
      WRITE (13, 2160)
      WRITE (13, 3480) (TOTCGUTM(I), I=1, NVAR), NSUMTRG, NSUMFRQ,

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INSUMERR
3480 FORMAT (1X, 'TOTAL', 26I4)
      WRITE (13, 3485)
3485 FORMAT (/5X,'* -- Indicates this is an ideal scale type')
C
C (10) Print out the Guttman Reproducibility Index
C
      WRITE (13, 3500)
3500 FORMAT (/, 'G. The Guttman Coefficient of Reproducibility')
      WRITE (13, 3550) TOTERR
3550 FORMAT (/, 5X, 'Number of Errors = ', I4)
      WRITE (13, 3575) NVAR
3575 FORMAT (5X, 'Number of Items = ', I2)
      WRITE (13, 3555) NSELECT
3555 FORMAT (5X, 'Number of Respondents = ', I4)
      WRITE (13, 3560) NSELECT*NVAR
3560 FORMAT (5X, 'Total Responses = ', I5)
      WRITE (13, 3600) REPRO
3600 FORMAT (/5X,'Rep = Number of Errors/(Number of Respondents*Number
      1 of Items) = ', F6.3, /)

C
C (11) Print out the Kuder Richardson Index of Reliability
C   For Dichotomized Variables
C
      WRITE (13, 3725)
3725 FORMAT (/,'H. Kuder Richardson Index from Formula KR20',/)
      WRITE (13, 3730) SUMPQ
3730 FORMAT (5X, 'Sum of Item Variances = ', F8.3)
      WRITE (13, 3750) TOTVARD
3750 FORMAT (5X, 'Total Score Variance = ', F8.3)
      WRITE (13, 3775) KR20D
3775 FORMAT (/, 5X, 'KR20 =  $K/(K-1)[1-(SUMP*Q/TOTAL\ VARIANCE)]$  = ',
      1F6.3,/)
      WRITE (13, 3776)
3776 FORMAT (/, 'I. Inferred Average Inter-Item Correlation',/)
      WRITE (13, 3777) INFAVED
3777 FORMAT (5X, 'IAC = Reliability/[ $K+(1-K)(Reliability)$ ] = ',
      1F8.3)

C
C (12) Print out the Analysis of Multilevel Responses
C
      WRITE (13,3780)

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3780 FORMAT (///, 'SECTION III. ANALYSIS OF MULTILEVEL RESPONSES'
1,/)
WRITE (13,3800)
3800 FORMAT (/, 2X, 'A. Inter-Item Covariance Matrix',/)
DO 3805 I=1,NVAR
WRITE (13,3810) (RELI(I,J), J=1,NVAR)
3805 CONTINUE
3810 FORMAT (26(F7.2))
WRITE (13, 3815)
3815 FORMAT (//,2X, 'B. Pearson Product-Moment Correlation Matrix',/)
DO 3820 I=1,NVAR
WRITE (13,3810) (PEARSN(I,J), J=1,NVAR)
3820 CONTINUE
WRITE (13, 3825)
3825 FORMAT (//, 2X, 'C. Item-Total Correlation Matrix', /)
WRITE (13, 3850) (VARNAME(I), I=1,NVAR)
3850 FORMAT (5X, 'ITEM', 26A8)
WRITE (13,3875) (COVSCTT(I), I=1,NVAR)
3875 FORMAT (5X, 'COVAR', 26F8.2)
WRITE (13,3880) (STDSCCTT(I), I=1,NVAR)
3880 FORMAT (5X, ' r ', 26F8.2)
WRITE (13, 3785)
3785 FORMAT (//, 2X, 'D. Kuder-Richardson Reliability',/)
WRITE (13, 3790) NVAR
3790 FORMAT (5X, 'K =', I4)
WRITE (13, 3791) SUMVITM
3791 FORMAT (5X, 'Sum of Item Variances = ', F8.2)
WRITE (13, 3792) TOTVAR
3792 FORMAT (5X, 'Total Score Variance =', F8.2,/)
WRITE (13, 3793) KR20M
3793 FORMAT (5X, 'KR = K/(K-1)[1-(SUM OF ITEM VARIANCES/TOTAL VARIANCE)]
1 = ',F6.3)
WRITE (13, 3795)
3795 FORMAT (//, 2X, 'E. Inferred Average Correlations')
WRITE (13, 1800) INFAVEM
1800 FORMAT (/,5X, 'IAC = RELIABILITY/[K+(1-K)(RELIABILITY)] = ',
1F6.3 )
STOP
END
C
C ***** SUBROUTINES *****
C
C SUBROUTINE (1) -- REORDER (REVERSE) THE SEQUENCE OF ANSWERS FOR THE

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C          VARIABLES WHICH HAVE REVERSE(I)=1
SUBROUTINE REORDER(N, K, NSELECT, SCORE, NCOLUMN, MAXSC)
INTEGER SCORE(N, K)
DO 10 I=1, NSELECT
  SCREV=(MAXSC+1)-SCORE(I, NCOLUMN)
  SCORE(I, NCOLUMN)=SCREV
10 CONTINUE
  RETURN
  END

C
C SUBROUTINE (2) -- CALCULATE THE MEAN, VARIANCE AND STD OF A SCALE
C          ITEM BY GIVING THE SCORE MATRIX--SCM(NSELECT, NVAR)
C          (NC IS THE NUMBER OF COLUMN WHERE THE SCALE ITEM IS LOCATED)
C
SUBROUTINE MEAN(N, K, NSELECT, NVAR, SCM, NC, SCMEAN, VAR, STD)
INTEGER SCM(N, K)
SUM=0.0
DO 10 I=1, NSELECT
10 SUM=SUM+REAL(SCM(I, NC))
  SCMEAN=SUM/REAL(NSELECT)
  VAR=0.0
  DO 20 I=1,NSELECT
20 VAR=VAR+(REAL(SCM(I, NC))-SCMEAN)**2
  VAR=VAR/REAL(NSELECT-1)
  STD=VAR**0.5
  RETURN
  END

C
C SUBROUTINE (3) -- CALCULATE THE FREQUENCY AND PERCENTAGE OF
DISTRIBUTION
C          FOR A SCALE VARIABLE -- THE NCOLUMNth IN THE SCORE
C          MATRIX SCM(NSELECT, NVAR)
C
SUBROUTINE FREQ(N,K,NSELECT,NVAR,NANSWER,NCOLUMN,SCM,DISTR,PRCNT)
INTEGER SCM(N, K), DISTR(NANSWER)
DIMENSION PRCNT(NANSWER)
DO 10 I=1, NANSWER
10 DISTR(I)=0
  DO 20 I=1, NSELECT
  DO 30 J=1, NANSWER
    IF (SCM(I,NCOLUMN).EQ.J) THEN
      DISTR(J)=DISTR(J)+1
      GO TO 20

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        END IF
30 CONTINUE
20 CONTINUE
    DO 40 I=1, NANSWER
40 PRCNT(I)=REAL(DISTR(I))/REAL(NSELECT)
    RETURN
    END
C
C SUBROUTINE (4) -- CALCULATE THE TOTAL OF EACH ROW AND COLUMN
C      OF THE SCORE MATRIX
    SUBROUTINE TOTAL(N, K, NROW, NCOL, MATRIX, TOTROW, TOTCOL)
    INTEGER MATRIX(N,K), TOTROW(NROW), TOTCOL(NCOL)
    DO 10 I=1, NROW
    TOTROW(I)=0
    DO 10 J=1, NCOL
    TOTROW(I)=TOTROW(I)+MATRIX(I,J)
10 CONTINUE
    DO 20 I=1, NCOL
    TOTCOL(I)=0
    DO 20 J=1, NROW
    TOTCOL(I)=TOTCOL(I)+MATRIX(J, I)
20 CONTINUE
    RETURN
    END
C
C SUBROUTINE (5) -- FOR FORMING THE TERM SIGMA(I,J) IN THE
C      RELIABILITY MATRIX FOR A GIVEN SCORE MATRIX
C
    SUBROUTINE RELIAB(N, K, NSELECT, NVAR, SC, NI, NJ, COVXY, RXY)
    INTEGER SC(N,K)
C CALCULATE THE MEAN, VARIANCE AND STD OF THE Ith AND Jth COLUMN
    CALL MEAN(N, K, NSELECT, NVAR, SC, NI, XMEAN, XVAR, XSTD)
    CALL MEAN(N, K, NSELECT, NVAR, SC, NJ, YMEAN, YVAR, YSTD)
    COVXY=0.0
C CALCULATE THE COVARIANCE OF Ith AND Jth COLUMN OF MATRIX SC(N,K)
    DO 20 I=1,NSELECT
20 COVXY=COVXY+(REAL(SC(I,NI))-XMEAN)*(REAL(SC(I,NJ))-YMEAN)
    COVXY=COVXY/REAL(NSELECT-1)
    RXY=COVXY/(XSTD*YSTD)
    RETURN
    END

```

VITA

The author was born to Yin-Ao Yu and Run-Ping Yang in the city of Beijing, the capital of the People's Republic of China, on July 13, 1962. Upon finishing high school she entered Shanghai Building Material Institute in Shanghai in the fall of 1979 where she majored in Business Management. She received a Bachelor degree in Business Management in July of 1983. She then was employed by China Academe of Building Material (CABM) and worked there for five years until she came to the USA.

The graduate study in the Department of Social Relations (now called Sociology and Anthropology) at Lehigh University began in the fall semester of 1991. She has been studying all the courses required by the department while she is sometimes working on some projects. She will graduate in January of 1994 with a Master of Science degree in Social Psychology.

The author was married to Mr. Yi Zhou in June 1987.

**END
OF
TITLE**